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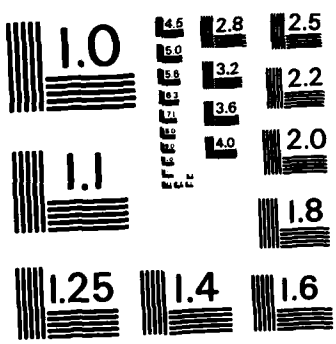

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How to Discipline Electronic Acquisition

General Lawrence A. Skantze, USAF

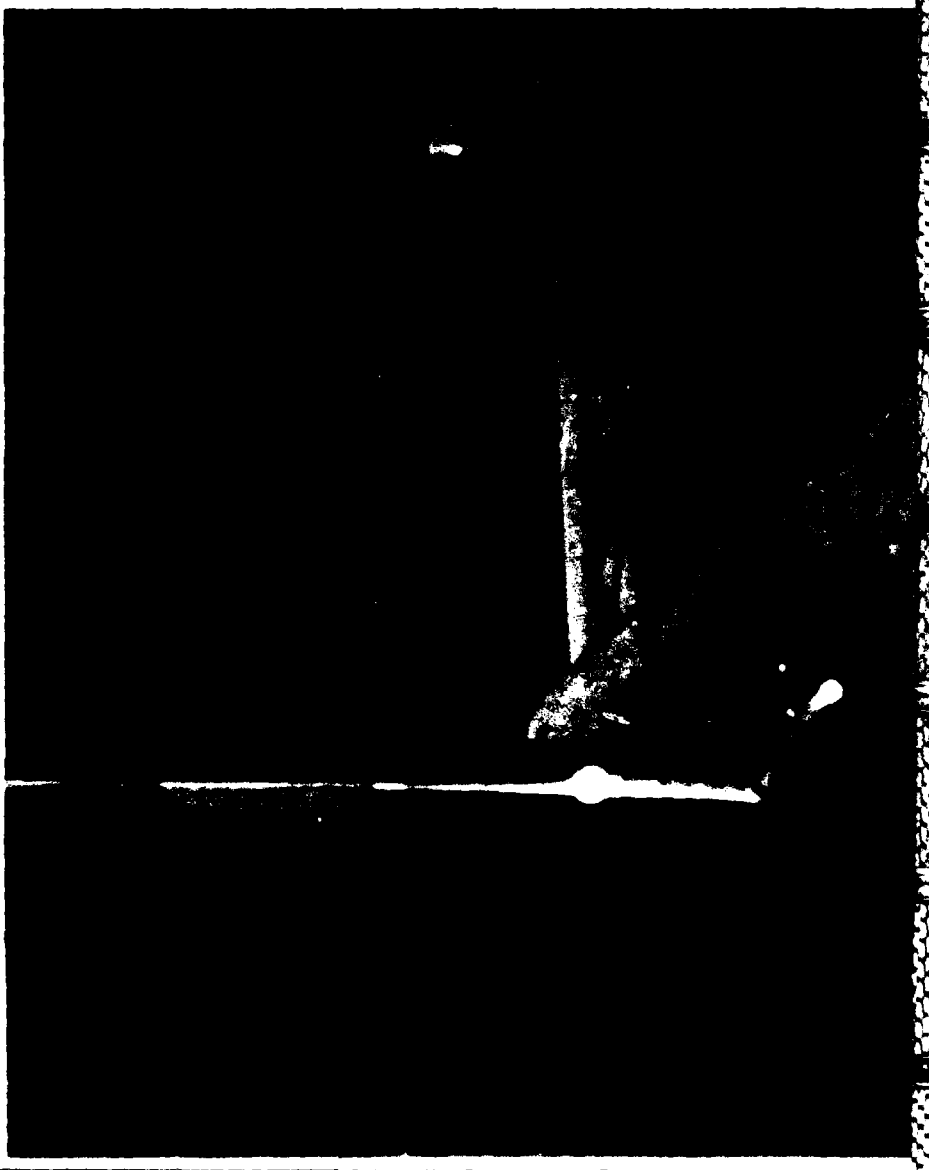
We rely on electronics in every one of our primary and support mission areas. It's the guts of avionics, shop test equipment, management information systems, and, of course, command, control, and communications. New electronics technologies are emerging at a galloping rate. This is both a blessing and a bane for weapon systems development. Technology advances give us capabilities essential to meeting new operational requirements. Our dilemma starts with the fact that technologies evolve faster than the acquisition cycle of the systems they can improve. The technologies can be a vehicle by which additional capabilities can be added after we've set requirements. And that fact contributes to one of the toughest managerial challenges faced by the Air Force and the electronics industry: how to discipline acquisition management to hold the line on requirements.

Managing Requirements

Managing requirements for C^3 (command, control and communications) systems is a greater challenge than managing systems in other mission areas. That's primarily due to the large number of customers for C^3 and the network to meet their needs.

After we've set requirements for the proverbial Block I (increment of change), all levels of the Department of Defense and industry have to agree to corral any emerging technologies until Block II. Otherwise, we can easily reach a point where we won't be able to freeze a C^3 system configuration long enough to produce and field it. In successful C^3 programs, like any acquisition program, there comes a time to shoot the innovators and get on with production. It's just been harder to do in C^3 programs.

The interfaces of C^3 players are complicated. So is the network that ties them together. The TRI-TAC (tri-service tactical communications program) is an example of a system whose complexity is multiplied due to the management problem of coordinating multiservice requirements, obtaining program resources, and maintaining configuration control when dealing with not just the Air Force, but the Army and Navy too.

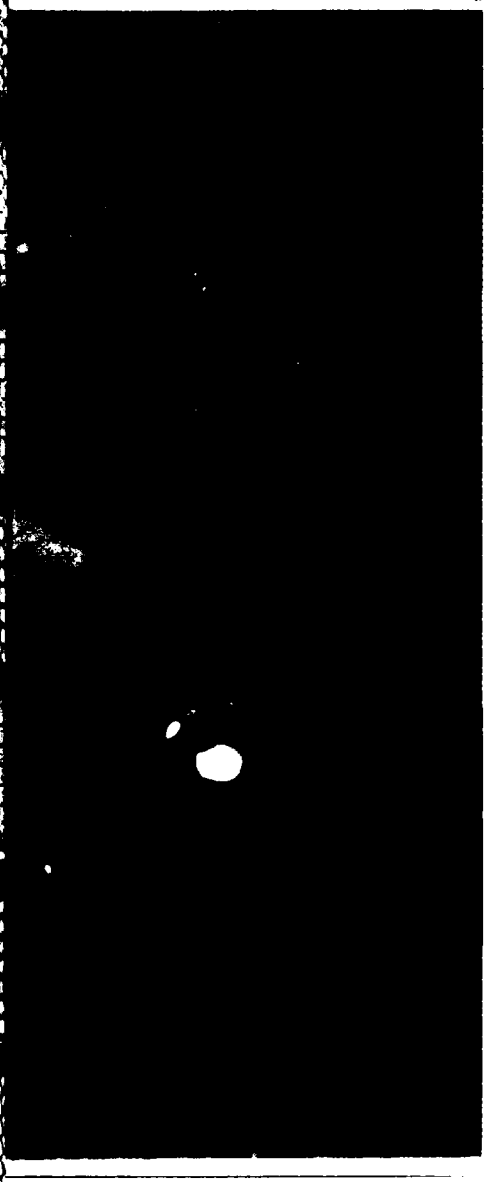


This is taken from remarks delivered by General Skantze to the Air Force Association National Symposium in Wakefield, Mass., the past spring.

The interfaces of C^3 players are complicated . . . . Additional levels of management complexity occur when NATO allies are involved, as with AWACS (airborne warning and control system)

The worldwide military command and control information system and MILSTAR (a military satellite communications system) are other examples. Additional levels of management complexity occur when NATO allies are involved, as with AWACS (airborne warning and control system).

Boeing



The temptation of developers is to be all things to all customers. And speaking frankly, the temptation of users is to heed the siren song of peak performance now rather than look toward growth capability for the next block change.

I've heard persuasive arguments by industry that altering a design will only minimally impact cost and schedule. Both contractors and users have approached our program offices to push for extras. It's often only the discipline of a program manager that determines whether we'll keep the program on track. If the contractor or the user has been whispering in the ear of a contact at the Pentagon or on Capitol Hill, the program manager's autonomy can be undermined. Changing requirements introduce risk. At worst, they also increase cost, stretch the acquisition life cycle, and delay delivery of a critical weapon system.

State-of-the-Art Advances

The short life cycle of emerging technologies, notably in the electronics realm, aggravates the requirements creep. The typical advanced component stays out in front for only a few years before becoming obsolete, and the interval between major state-of-the-art advances is decreasing. However, the acquisition life cycle for a C^3 system like a radar is still at least 5 to 7 years. In some instances we have succumbed to adding new requirements in the design stage for more capability; and we've suffered the consequences.

Enhanced JTIDS (joint tactical information distribution system)—EJS—is a case in point. The initial operating capability for this secure communications radio has slipped 7 years. Since the program started, under the name "Seek Talk," EJS has grown from a jam-resistant voice radio in the UHF band to include interoperability with JTIDS in L-band, addition of a TACAN (tactical air navigation) capability, operation in an alternate band, and capability to pass a limited quantity of data in both the L-band and alternate band.

We're facing a similar problem with SINCGARS (single channel ground airborne radio systems), a VHF jam-resistant radio. The availability of more complex integrated circuits offers us the potential to incorporate COMSEC (communications security) devices within radios rather than as separate boxes. This is a good idea, but if we try to include this technology now, just as we're about to award a development contract, we will delay SINCGARS by as much as a year.

Our other C^3 systems will suffer the same delays and cost increases unless we declare a moratorium on new requirements early in the development process. No moratorium can be absolute. The program manager will always have the discretion to incorporate technology changes to meet requirements. However, when a program manager declares the need for a moratorium, having the entire defense community support him would do more to improve the C^3 acquisition process, contain costs, and get delivery dates met than would any other management initiative.

Disciplined Acquisition

We've held the line before. We've negotiated users' needs to promote commonality, squelched proliferation of configurations, and avoided delays in fielding a block design. There are systems whose acquisition process has been disciplined in the face of emerging requirements and electronics technologies that provided the vehicle for incorporating these new requirements.

For instance, "Have Quick" was a relatively simple system developed to fill an immediate need for anti-jam voice communications. We've improved it as required to keep it viable. Advances in synthesizer and large-scale integration technologies enabled us to field this frequency-hopping UHF jam-resistant voice radio in the same envelope occupied by our existing ARC-164 narrow-band UHF-AM radio. This means the "Have Quick" retrofit is made at the unit level of low cost. To date, more than 8,000 of these form, fit, function replacements for existing radios have been fielded for about $3,500 each.

The E-3 is another good example of a C^3 system fielded against changing operational requirements. When we began the program, the goal was an airborne early warning radar for continental U.S. defense. While some of our E-3s are used for this purpose, their primary mission is tactical airborne command and control. In this capacity, the E-3 is one of the most effective crisis management tools of the joint chiefs of staff. Along the development path, upgrades were needed.

A block approach was used for system improvements. First we fielded a core airplane with a basic configuration. In the second block we improved the radar and computer. In the third block we're capitalizing on advances in filtering technologies in communication systems. And keeping changes at a manageable level, we're now planning another block to take advantage of new technology. For instance, the E-3 multistage improvement plan will apply very-high-speed integrated circuit (VHSIC) technology for improved radar data correlation, increased radar sensitivity, and ECCOM (electronic counter-countermeasures) improvements, among others.

The E-3 block approach froze improvements for each iteration, but we identified and ranked additional change candidates for future block implementation.

I managed the development and initial production of the AWACS program and know full well the importance of the block advances. I'm not advocating a moratorium on changing C^3 requirements or disallowing new requirements and technologies to realize them. I'm advocating a moratorium on what goes into each block.

What to Do?

So what do we have to do?

First, clearly define requirements for C^3I (command, control, communications and intelligence) systems. The user has to understand that new "nice-to-haves" won't necessarily be incorporated into the system baseline. The corollary is: If the new requirements relate to a valid change in the threat and what we're working on doesn't meet that threat, we also need to face up to cancelling development early.

Second, all players in system development—user, developer, supporter and trainer—must work closely to understand the user's needs and the availability of technology to support them. Let's not promise what we can't deliver. Let's keep advanced technology in the laboratories until it's mature enough to transition.

Third, we need to study what's already out there and use it rather than reinventing the wheel. That means focusing on common systems to fill the needs of many users. More commonality between C^3 systems, where practicable, will provide the operator with more reduncancy between echelons and greater survivability. For example, many of our systems depend on jam-resistant radios. For each requirement, we are using our existing AJ (anti-jam) architecture to accommodate these needs. It's important, though, to balance the advantage of using common C^3I systems for several missions against the increased complexity and risk associated with those common multimission systems.

Fourth, we have to look at making simple enhancements to existing systems to meet new requirements. Pre-planned product improvement, or P^3I, makes sense. Many of our new systems do have P^3I plans. The EJS, for example, includes a VHSIC insertion plan for more capability to meet future requirements. And as part of the P^3I approach, we should plan block retrofits for systems.

Fifth, after selecting a block, let's stand firm on its contents. Industry has to stop racing through DOD and the Congress with hot new advances or promising more than can be delivered. The services have to stop wattling on requirements and asking for more than we need. While I'm on a roll, let me point out that we often have the help of others in gumming things up.

Sixth, we have to emphasize competition. In many cases, we can compete block changes. That way, we don't limit ourselves to the original supplier. Effective competition lets us find the best qualified contractor. It broadens the industrial base and gets the most value for each defense dollar.

Seventh, when a contractor gives us new ideas, he should understand and articulate to us all the impacts on an existing development program.

Eighth, to make sure requirements are met, we must agree early-on in the acquisition cycle on what to test, how to test, and what constitutes pass and fail. Part of holding the line on new requirements is using the same requirements in the test baseline as we designed to.

Last, we need to write clear contracts that explicitly state requirements

■ *General Skantze is the commander of the Air Force Systems Command.*

before we sign them. No more big contracts followed closely by even bigger changes.

If we execute these points, we can slam the lid on creeping requirements and get our weapon systems into the field.

Shortened Acquisition Time

No promise of performance is worth a dime unless we can bring in new systems on time and within cost. We've got the means to shorten the acquisition time frame and reduce costs. We need the willpower to do it. The longer the acquisition cycle, the more we're spending.

It's important to remember whose money that is. It belongs to taxpayers and is appropriated by the Congress. The last few months have demonstrated how difficult are the trade-offs among defense, social programs, balanced budgets, and tax levels. We can't expect a favorable reception if we have to ask for more money to cover defense overruns.

The Congress is in no mood to tolerate cost growth of significant amounts for defense programs. This year, for the first time in recent history, a major Air Force program, a munitions system, was cancelled due to a breach of the Nunn-McCurdy Act. The act calls for reports to the Congress and constraints on obligations of funds whenever a program's costs exceed 15 percent of original estimates.

The E-3 multistage improvement plan will apply very-high-speed integrated circuit (VHSIC) technology for improved radar data correlation, increased radar sensitivity, and ECCOM (electronic counter-countermeasures) improvements, among others.

Though no C^3 systems have been cancelled for Nunn-McCurdy breaches, they would not be exempt in today's fishbowl world of defense procurement where full public and press scrutiny attends our every move.

I'm not the first Air Force acquisition manager to insist on the need to contain costs by disciplining acquisition management. However, I am the current one charged with this responsibility. And I'm working with you in a hardball defense procurement arena. Defense acquisitions have become everyone's business. I firmly believe that our future success depends on doing things right from the outset.

C^3 is big business. In fiscal 1985, the Air Force budgeted almost $9 billion for C^3 programs, which is 48 percent of DOD total C^3 programs. In FY 86, the budget request is for $10 billion, or 46 percent of the total DOD C^3 request.

And C^3 is business-critical to the national defense. They (C^3 systems) correlate the battle situation. Since World War I the complexion of the battlefield has changed drastically. More weapons, traveling at greater speeds, covering larger areas, have dramatically increased the load on C^3 systems. In the complex battle arena, commanders depend on C^3I for a meaningful picture.

The adversary knows well the importance of C^3 to combat operations. The Soviet policy of countering our C^3I systems places an additional pressure on requirements creep. But rushing back to the drawing boards with new technological discoveries, and trying to incorporate them into full-scale development programs before maturity or at the price of design reiterations, puts our C^3 programs at risk. As a matter of standard operating procedure, once we pass critical design review, we should execute any engineer who promises five more DB (decibels) without any design impact.

There will always be a better, simpler, cheaper way to build a weapon system. Those of us in the business of designing and producing new C^3 systems must balance that fact with this specific challenge: turning new programs into hard realities on time and within cost. I'm confident we will meet the challenge.■

Early Detection of a Seller's Pricing Strategy

Willis R. Greer, Jr.

The year is 1995. For some time now, two contractors, Aheed and Bing, have been engaged in joint development of the new X-99C airframe. The Department of Defense (DOD) is pleased with the resulting design and the production phase is ready to begin.

The DOD program manager (PM) has decided to procure this airframe from only one of the two firms. [1] Accordingly, it was communicated to both Aheed and Bing that a single contract for 500 units will be awarded competitively. The schedule calls for delivery of 100 units per year over a 5-year period.

The contract is to be of a new type known as "negotiated profit." The producer's costs and operating efficiency will be carefully monitored and, if satisfactory, a profit equal to prenegotiated percentage of cost will be allowed.[2]

As a part of the bid preparation process, both firms prepared "first-unit price" estimates (which, of course, include the agreed-upon profit allowance). The PM now has these estimates in hand:

Aheed	$20,000,000
Bing	$18,000,000

The PM reviews the bids one final time, smiles, turns toward the visiphone and announces the result. Aheed wins! Simultaneously (as required under the Fair Contracting Act of 1990), a facsimile of the analysis which led to this decision is transmitted to each firm. The analysis clearly shows that the PM's decision has saved DOD more than $150,000,000.

Some Underlying Theory

At this point it will be necessary to digress and perhaps refresh the reader's memory about some basic theory with which our PM is already quite familiar. There are two propositions we must explore. One of these is the theory of pricing strategy in the scenario of a new product introduction. The other is the theory of learning curves.

Contractor Pricing Strategy

When firms introduce new technology or innovation to the *commercial* marketplace it is common for them to use one of two product pricing strategies: "penetration" or "skimming the cream." These two strategies were first identified and described by Joel Dean, but they have since been elaborated on and discussed by many authors.[3] They seem to be both widely understood and used by business practitioners.

The concept behind "penetration" is to diffuse the appeal of the product as rapidly as possible through very low initial pricing; then, once the market is "penetrated," to take advantage of cost reductions and/or price increases to generate healthy profits. The strength of the penetrator's position discourages would-be competitors from attempting to enter the market.

A "skimming the cream" strategy calls for very high initial pricing followed by a series of reductions, timed carefully so as to reap as much profit as possible at each step. The firm must be careful to keep one price ahead of would-be competitors. The advantage of skimming is a more nearly instantaneous return on investment: the risk is that a would-be competitor will outwit you and get into the market, or that your customers will become enraged by your apparent profiteering.

The DOD acquisition world parlance for these two strategies describes a "relationship" between "first-unit price" and the "price-reduction rate." A penetration strategy manifests itself as a relatively low first-unit price in combination with a fairly "flat" price-reduction curve. Cream skimmers display a higher first-unit price, but a steeper price reduction curve.

Learning Curve Theory

Learning theory has been with us for a long time.[4] Basically, the theory describes the declining production costs a manufacturer expects to occur with increases in the cumulative quantity produced of a new product. A common mathematical expression for the phenomenon is:

$$C = AX^B; \text{ or in log form,}$$

$$\ln C = \ln A \, ^{s} \, B \, (\ln X)$$

C is the cost of the Xth unit produced. The constant A represents the cost of the first unit. The exponent, B, must be negative if cost is to decline with experience.[5] For example, if B were equal to zero, the cost of *every* unit produced would be A. If B were positive, C would grow with experience.

Learning curves are usually described in terms of their slope, s, where s is related to B as follows:

$$B = \frac{\ln s}{\ln 2}$$

■ *Dr. Greer is chairman, Department of Administrative Sciences, and professor of accounting at the Naval Postgraduate School, Monterey, Calif.*

While greater extremes are not rare, slopes of .800 to .900 are common for complex, high-technology products—such as the new X-99C airframe. These values of s correspond to values of B between -.322 and -.152, respectively. A slope value of 1.000 would produce a zero value of B.

When DOD cost analysts study learning curves they are usually more interested in describing reductions in contractor *price* through time than they are in the contractor's *cost*. The resulting curve is therefore more properly termed a price-reduction curve than a learning curve. The meaning of A becomes the first-unit *price*, and the slope, s, describes the price-reduction rate.

It will be important for the reader to recognize that the slope of the price-reduction curve is a matter of *economic indifference* to the *contractor* so long as it is combined with a first-unit price which causes total profits with the *same present value* to be earned on the contract.[6] Therefore, the relationship between first-unit price and the price-reduction rate is a strategic decision. Said another way, to skim or penetrate does not *in and of itself* affect the immediate value of the contract in question.

The same indifference carries over to the buyer. If the present value of the total purchase price over time is the criterion, neither the first-unit price nor the price-reduction rate alone is of much consequence. What matters is the *combination* of the two.

Some Examples

An example or two might help to cement these concepts in place. Let's use the X-99C airframe.

Suppose, for these examples, that both the contractors and DOD assess the time value of money to be 10 percent with annual compounding. This means a dollar of cost which must be incurred, say, 3 years in the future, is equivalent to having to spend only about $.75 today.

If the contractor shows, say, an .800 price-reduction curve, the series of prices which runs off into the future will decline rather rapidly. Let's combine this .800 unit price-reduction slope with a first-unit price of $30,000,000. By the time the 500th X-99C airframe is produced (at the end of the fifth year of the procurement phase), the price will have dropped to $4,057,392. The total purchase price of all 500 units will be $2,965,417,000, but the *present value* of the total price, at the start of the procurement phase, will be less: $2,465,460,000.

But now suppose the contractor will present a "flatter," .900 price-reduction curve. Even a first-unit price as low as $15,000,000 would still be insufficient to offset the flatter slope. The price of the 500th airframe would have dropped only to $5,832,295. The present value of the total price under this combination would be 2,782,468,000 or more than $300,000,000 higher.

Note, however, it *is* possible to calculate an indifference point—a first-unit price which, when combined with the .900 slope, would produce the *same* $2,465,460,000 present value of the total purchase price found for the first combination ($30,000,000, .800). The equality (or indifference point) occurs at a first-unit price of $13,291,040. The values associated with these two points are summarized in Table 1.

Strategic Incentives

As Chester Wasson has pointed out,

> The firm has more leeway in its pricing during the introduction of a high-learning product than it will ever have again, either in that product or with any other kind of product.[7]

That is to say, when firms introduce new technology to commercial markets they are in a position of maximum flexibility in choosing between the two product pricing strategies, penetration or skimming the cream. They have considerable freedom in selecting a combination of first-unit price and price-reduction rate.

There are clear economic incentives for an *early buyer* of innovation to source from a penetrator, but a "late-life" buyer might wish to seek out a cream-skimming supplier. A *large* early purchaser might be in a position to foil a cream skimmer's initial attempts by encouraging competition (thereby accentuating the steepness of the price-reduction curve). This is part of the rationale for second sourcing. Under these conditions, early diagnosis of a seller's pricing strategy can lead to substantial cost reductions for a resourceful buyer.

Unfortunately, the incentives for the seller all lead to concealment of the strategy selected. A skimmer may be fearful that buyers will delay purchasing decisions until prices decline. The penetrator does not want competitors to anticipate the inevitably flat price reduction curve. Also unfortunately, both generally accepted accounting principles and, as we shall see, the promulgations of the CASB, include sufficient flexibility to *allow* concealment even when "cost" data lie within the public domain.

When, as is the case with the X-99C, the purchaser will procure from the contractor as a sole source throughout the *entire production phase* of the program, the incentives are less clear. the seller may be fearful of premature termination of a program, or might suspect that a second source will be brought up. If so, the skimming choice is likely so that maximum profits can be earned early in the program—before the dreaded evvent occurs. On the other hand, if there is no fear of premature termination, but if the contractor seeks to minimize the *likelihood* of a second source appearing, the penetration strategy would be best. It would keep the market relatively unattractive to would-be competitors until it is "too late."

The buyer might well not care what choice is made by the contractor. As the indifference combinations in Table 1 show, it is possible for either strategy to constitute an identical economic sacrifice.[8] However, before that judgment can be made it is absolutely necessary that the buyer be able to make an early diagnosis of a seller's pricing strategy. Otherwise, there will be no way of really knowing which of two first-unit price bids actually presents the lowest-cost procurement option.

Strategic Variables

The PM is still smiling as the visiphone screen fades and then goes blank. The original copy of the disk from which the facsimile of the analysis has just been transmitted to Aheed and Bing slides back out of its reading unit. It's after East-Coast working hours. The PM thinks for a moment about going home, but instead pushes the disk back into the reader and touches a sensor-spot marked "overview." The visi-phone screen pops back to life, but this time

TABLE 1. Two Indifference Points for the X-99C Airframe

First-Unit Price	Slope of Curve	Present Value of Total Purchase Price
$30,000,000	.800	$2,465,460,000
$13,291,040	.900	$2,465,460,000

it shows a wide-angle view of the entire analysis. A finger-tap on a point near the top left corner of the screen produces an enlargement containing the equivalent of two pages of the analysis.

On display now the direct costs Aheed and Bing were each expected to incur had they been selected to produce the X-99C airframe. There are references to long lists of subcomponents (which can be called up with appropriate finger-taps), but the PM does not ask for this detail. It's not terribly relevant anyway; such costs would be virtually identical for either contractor. And the cost of purchasing the materials that would be held in inventory by either firm until needed would be the same. Yes, there is still a little inflation (even in 1995) but its effect would be the same on Aheed as on Bing. Even the labor cost would be the same. A joint development process tends to result in the use of very similar production procedurs, and all companies in the aerospace industry now draw from a shared pool of skilled workers at uniform wages rates. (That practice went a long way toward solving the industry's unemployment problems!) In fact, the PM feels no need to produce a sweep forecast of any of these cost elements (which could be done with a fingertip). They would decline through time at the same rate for both companies.

Rather, the PM's interest is drawn toward a small area of the analysis marked:

Interperiod Allocation of Costs

Aheed----------

Bing ----------

A new finger-tap brings an explosion of detail to the screen. "Now here," reflects the PM, "are the strategic variables."

Of Mice, Men and Accountants

The reader may well be somewhat skeptical about the degree to which a seller has control over pricing strategy in the environment of a contractor/DOD relationship—particularly under an instrument such as the fictitious negotiated profit contract. After all, how much flexibility could even a resourceful accountant find within the confines of the CASB's articulate promulgations?[9] Well, how much freedom of choice does a contractor have in making interperiod allocations of costs?

Interperiod allocations of cost are necessary under generally accepted accounting principles when an expenditure will clearly benefit the activities of the firm during more than one accounting period. Depreciation is a good example. A contractor may purchase a group of tangible assets, such as equipment for manufacturing X-99C airframes, at the beginning of the production phase, but the equipment will be used for the duration of the program. The cost of the equipment is therefore spread over, or allocated to, the accounting periods (quarters, years) during which it is to be used.

In CAS 409, *Depreciation of Tangible Capital Assets*, the CASB requires, in effect, that the contractor choose depreciation methods which are consistent with those used for financial reporting. It (409) "further requires that support be developed for reasonable estimates of asset service lives." The combined effect is to permit the contractor to spread the cost of equipment acquired for a particular program over the units produced in accordance with any of the popular depreciation methods. These include (but are not limited to) straight-line, sum-of-years'-digits and declining balance.[10] An accelerated method choice will cause relatively more "cost" to attach to units produced early in the program and relatively less to the latter production. This, in turn, will cause the learning curve to be steeper. And, if price is tied to cost, the slope of the price-reduction curve could be steeper as well. Strategic variable one.

It may not be immediately obvious, but the inventory accounting method choice provides another means by which the interperiod allocation of cost can be controlled. This is particularly true when "there is still a little inflation." Remember our PM noted, "the cost of purchasing the material that would be held in inventory by either firm until needed would be the same." However, nothing was said about the cost which would be assigned to the materials taken *out* of inventory and *used* in the production process at different points in time. The accountant may elect (with certain restrictions) to use LIFO, FIFO, the Average Cost Method, or even some combination of these in making this assignment.[11] In an inflationary environment, LIFO generally results in earlier recognition of the rising costs of materials. Again, the learning curve is steeper; and so would be the slope of the price-reduction curve. Strategic variable two.

Costs, of course, are not the only interperiod allocation choices made by accountants. Some revenues and other credits are also allocated to or among time periods. Exactly *when* during a program the bulk of the profits become apparent is therefore sometimes subject to at least a bit of additional discretion. For example, consider the accounting for investment tax credits. The purchaser of eligible property can deduct a percentage of the cost of that property from its current income tax obligation. The Revenue Act of 1971 *legally permits* the taxpayer to choose between the "flow-through method" or the "deferral method" in accounting for the income effects of this credit.[12] Again, we have an opportunity for interperiod adjustments. However, this time the subject of the allocation is *unallowable* for determination of "cost" for contracting purposes. Therefore it *should be* irrelevant. But....

Remembrances

The PM thinks again, leans back, and taps another sensor-spot. This one is marked "history." The screen instantly flashes a menu containing many choices among the hundreds of

available facets of the history of interperiod allocations of costs—both for these two firms and as a general subject. The PM searches for a second or two and taps a menu item, "research." "In relation to what?" asks the screen, and displays another menu. "Price-reduction rates," responds the PM. "Early or recent?" The PM taps "early."

"The first work that was done on /...." The PM interrupts with a tap to "break," then switches to "voice." The machine starts again in clear, soft tones, "The first work that was done on the relationship between accounting method choices and price-reduction rates appeared about a decade ago. Its contribution to DOD management of major acquisition programs was that it enabled a PM to estimate the slope of the price-reduction curve a particular contractor would present on a program as a function of the accounting method choices made by the contractor when reporting its financial results in the annual report. Empirical data on the price histories of a number of airframes produced over a period of ...."

Predicting Price-Reduction Rates

There is in existence a rather remarkable compilation of aircraft cost statistics known as the *US Military Aircraft Cost Handbook*. This handbook was produced in March, 1983, and contains detailed cost histories for 108 aircraft, broken down by airframe, engines, electronics, armament and other.[13] Much of the data for the early research work referred to by the PM's computer was drawn from this handbook. The slopes of the unit price-reduction curves (based on constant dollars) for the airframes in question were of particular interest. However, in order to be included in the study, the program histories were required to pass certain tests for currency and content.

First, programs which were duplicates were eliminated. For example, histories for the F-106A and F-106B were presented both separately and together. The combined series was used. The individual programs were not.

Next, to assure relative currency of the data, programs with procurement phases which began prior to 1950 were dropped from consideration. This eliminated, for example, the B-47 series. Programs with procurement phases which did not extend at least into 1953 were also dropped. This eliminated the P-2E from consideration.

Finally, since the object of the research was to explain variations in price-reduction slopes, only programs which had well-defined price-reduction slopes were selected for inclusion in the group to be studied. This requirement was easily operationalized since the "fit" of the curve was reported for each program in the *US Military Aircraft Cost Handbook*. An r-squared value of at least .6 was required to qualify the program for inclusion. This eliminated programs such as the AH-1J and the F-14A from the sample.

Surviving Program Data

The data which survived the filters specified above are given in Table 2. The airframe identifier, manufacturer, procurement period, slope and r-squared value are shown for each of the programs used.

Table 2. Program Data Used in This Study

Identifier	Manufacturer	Years	Slope	R-squared
A-4B	McDonnell	'55-'57	.834	.920
A-4C	McDonnell	'57-'62	.894	.846
A-4E	McDonnell	'61-'64	.892	.921
A-6A	Grumman	'61-'69	.829	.962
A-7A/B	Vought	'65-'67	.852	.662
A-7D	Vought	'68-'75	.950	.705
AH-1G	Bell	'66-'71	.872	.928
AH-1S	Bell	'75-'80	.891	.731
AH-1T	Bell	'76-'78	1.021	.999
B-52G	Boeing	'57-'59	.869	.924
B-57B/C/E	Martin	'52-'55	.911	.696
F-1B/C/MF-1C	North American	'52-'55	.783	.937
F-4A/B	McDonnell	'59-'66	.834	.933
F-4D	McDonnell	'64-'66	.886	.988
F-8A/B/C	Vought	'55-'58	.831	.817
F-8D/E	Vought	'58-'63	.882	.792
F-15A	McDonnell	'73-'79	.917	.837
F/A-18A	McDonnell	'79-'82	.860	1.000
F-84F	Republic	'51-'53	.725	.998
F-86D	North American	'51-'53	.926	.939
F-86F	North American	'51-'53	.870	.998
F-89D	Northrop	'51-'54	.885	.814
F-100A/C	North American	'52-'55	.839	.946
F-100D	North American	'54-'56	.934	.738
F-101A/B/C	McDonnell	'54-'59	.802	.758
F-102A	Gen. Dynamics	'53-'57	.724	.921
F-105B/D	Republic	'57-'62	.759	.752
F-106A/B	Gen. Dynamics	'57-'59	.837	.623
P-3A	Lockheed	'60-'64	.718	.904
P-3B	Lockheed	'65-'67	.910	.746
S-3A	Lockheed	'72-'76	.846	.919

Contractor Data

Eleven different contractors are listed in Table 2. It was therefore necessary to diagnose the accounting method choices made by all 11. To facilitate doing so, a 1982 annual report was solicited from each company (or its successor). All 11 accommodated the request. Since each annual report contains a note describing the accounting methods used by the company, the information was readily available. It is displayed in Table 3.

Some quantitative information is also displayed in Table 3. The numbers in parentheses beneath each company's name is the average slope of the price-reduction rate presented by the company in question on the programs from Table 2 for which it was the contractor. Boeing is an easy example. It is listed in Table 2 as the contractor for only the B-52G, on which it presented

Table 3. Contractor Accounting Method Choices

Successor Corporation (Contractor)	Method Choice for Depreciation Investment Tax Credit Inventory	
The Boeing Company	Accelerated	(1)
(.869)	Deferred	(1)
	Average Cost	(3)
Fairchild Industries	Accelerated	(1)
(Republic)	Flow-through	(5)
(.742)	LIFO and Average Cost	(2)
General Dynamics	Accelerated	(1)
(.781)	Flow-through	(5)
	Average cost	(3)
Grumman Corporation	Accelerated	(1)
(.829)	Deferred (prior to 1982)	(1)
	LIFO, FIFO, Average Cost	(3)
The LTV Corporation	Straight-line	(5)
(Vought)	Flow-through	(5)
(.879)	LIFO	(1)
Lockheed Corporation	Accelerated	(1)
(.825)	Flow-through	(5)
	Average Cost	(3)
Martin Marietta	Accelerated in Aerospace	(1)
Corporation	Flow-through	(5)
(.991)	FIFO	(5)
McDonnell Douglas	Accelerated	(1)
Corporation	Flow-through and Deferred	(3)
(.865)	FIFO and Average Cost	(4)
Northrop Corporation	Accelerated and	
(.885)	Straight-line	(3)
	Flow-through	(5)
	FIFO	(5)
Rockwell International	Accelerated and	
(North American)	Straight-line	(3)
(.870)	Flow-through	(5)
	LIFO, FIFO, Average Cost	(3)
Textron Inc.	Accelerated and	
(Bell)	Straight-line	(3)
(.928)	Deferred	(1)
	LIFO and FIFO	(3)

a slope of .869, also its average. The numbers beside the accounting choices in Table 3 are more difficult to explain.

Recall from the discussion above that an accelerated depreciation method choice will cause relatively more "cost" to attach to units produced early in a program and that this, in turn, should cause the learning curve to appear to be steeper. An "accelerated" method choice should be associated with a "smaller" slope value. Accordingly, a value of one (1) was assigned to accelerated depreciation. Straight-line produces the opposite result, this method choice received a five (5). Companies such as Northrop, which use both accelerated and straight-line, were assigned a three (3).

The method of accounting for investment tax credit should have no impact on pricing strategy because income tax is not an allowable cost. However, this choice was assigned numbers as well so that the hypothesis of "no effect" could be tested. The flow-through method received a five (5) and the deferred treatment was given a one (1). McDonnell Douglas uses both methods, so it was assigned a three (3).

The readers should remember that, in an inflationary environment, LIFO generally causes earlier accounting recognition of the rising costs of materials. Again, the learning curve should tend to appear to be steeper; so LIFO received a one (1), FIFO a five (5), and average cost a three (3). Combinations were weighted linearly.[14]

Statistical Associations

"The rest was easy," muses the PM. "In fact, I can duplicate it quite simply." A finger taps a sensor-spot and the data sets are captured for analysis. Then a few seconds of editing, and the "regression" sensor-spot is tapped. The screen instantly displays: (see below) "Ah yes!"the PM thinks, "seems crude today, but not bad given the technology available then. The t-ratios are positive and statistically significant at the .05 level for both the depreciation method and inventory accounting choices—just as hypothesized. Companies electing accelerated depreciation and/or LIFO indeed do tend to exhibit steeper price-reduction rates than do those choosing other methods. Also, as expected, the method of accounting for the investment tax credit does not turn out to be a statistically significant determinant. Its inclusion in the regression did enhance the significance of the other variables, however, so many people believed there was some kind of connection. The negative sign caused a bit of chin rubbing as I recall. Some people reasoned that the immediate *net income* boost that the

Slope = .7061 + .0304 Depr - .0104 Tax + .0424 Inv

t-Ratios	**+2.37**	**−1.17**	**+2.86**
Significance	**.05**	**—**	**.05**

r-squared, .601

Standard error, .0508

flow-through method produces when new equipment is placed in service caused price negotiators on both sides of the table to seek more rapid write-offs than otherwise they would have. That, of course, would have steepened the slope of the curve. The Fair Contracting Act took care of that. It *required* us to look only at before-tax profits.

"Under the circumstances the r-squared and standard error values aren't too bad either. A close look at an analysis of residuals shows that the price-reduction rate slopes for Martin Marietta and Northrop were the big outliers. In retrospect it may not have been wise to have included them in the sample since they were both based on only one program—the B-57B C E in Martin Marietta's case and the F-89D for Northrop. If you leave these two out and do a rerun of the regression you get...let's see." The screen flashes again:

Slope = .6897 + .0411 Depr - .0130 Tax + .0434 Inv

t-Ratios	**+6.33**	**−3.20**	**+3.59**
Significance	**.01**	**.05**	**.02**

r-squared, .917

Standard error,.0204

"Just look at that r-squared: The significance levels of all three independent variables rise. This gives even more weight to the argument that negotiators were led astray by the effects of the investment tax credit. And the standard error drops, allowing even higher confidence in projections taken from the model."[15]

The PM looks at the screen once again and mentally reviews the rest of the analysis. The now-routine examination of the bidding contractors' methods of making interperiod allocations of costs had paid off this time.

Epilogue

The X-99C has been flying for some time now. Very good airplane. The actual procurement costs were right in line with the PM's estimates, too.

Just what *did* the PM do? Well, the analysis of the direct costs had been straightforward. Long before 1995, we understood the effects of learning well enough to estimate correctly the rate at which cost elements, such as labor hours, would recede through time. But the PM took advantage of the understanding developed only over the last 10 years or so to enable a [illegible] analysis to be made of the differences in the ways the two companies, Aheed and Bing, were assigning costs across the 500 units [illegible] produced. This extra effort made [illegible] that Aheed's price-[illegible] would have a slope of [illegible] program. Even though the [illegible] processes were nearly identical, and the direct cost learning curves were expected to be the same, the PM knew the price-reduction rate would be .88 for Bing. If you trace the consequences you will see that, even though Aheed's first-unit price was $20,000,000 ($2,000,000 higher than Bing's), the curve is so much steeper for Aheed that by time the 24th unit is reached they cross! The total purchase price of the 500 units was FY 95 $3,293,304,000 from Aheed. The price from Bing would have been FY 95 $3,497,754,000—a classic "buy in" or penetration pricing strategy. On a present value basis these two figures drop to $2,695,067,000 and $2,848,805,000—thus the decision "saved DOD more than $150,000,000."

When the PM conducted the analysis the costs were built up unit-at-a-time, including both the allocations of depreciation and the accounting cost of materials *used* from inventory. Thus, the price-reduction rates cited above were just a summary statement of the detailed build-up of the cost of the 500 separate units. However, even the simple formula found by the researcher a decade before the PM's decision could have been used as a first approximation. Recall, it was:

Slope = .7061 + .0304 Depr − .0104 Tax + .0424 Inv

The allocation-method portion of the study showed Aheed used,

Accelerated	**(1)**
Deferred	**(1)**
Average cost	**(3)**

While Bing used,

Accelerated and Straight-line	**(3)**
Deferred	**(1)**
LIFO and Average Cost	**(2)**

If you run these accounting choice values through the regression you obtain estimates of .853 for Aheed and .872 for Bing. But don't forget the Fair Contracting Act of 1990! Remember, it *required* us to look only at before-tax profits. This, in effect, eliminated the influence of the "tax" term in the regression, raising each estimate by about .01, and getting us very close indeed to the .86 and .88 found by the PM.■

NOTES

1. Why? Simple. The PM forecast that capacity utilization in the aerospace industry would be over 80 percent during the procurement phase of this program. This condition is not consistent with economically successful dual-source competition. See Greer, W.R., Jr., and Liao, S.S., "Cost Analysis for Dual Source Weapon Procurement," Naval Postgraduate School Technical Report NPS54-83-011, October 1983, for a complete explanation of "the 80 percent rule."

2. The reader will recognize this contract as similar to the old "cost plus." The important difference lies in the suggestion of an ability to monitor costs so as to guarantee valid operating efficiency. It should be mentioned that the "negotiated profit" contract does not currently exist. See FAR Part 16.

3. See Dean, J., "Pricing Pioneering Products," *Journal of Industrial Economics*, (July 1969), pp. 180-187. But the reader might like to explore these concepts further. One good source of additional information is Wind, Y. J., *Product Policy: Concepts, Methods, and Strategy*, Addision-Wesley, 1982, who, on p. 378, says, "The high (skimming) versus low (penetration) introductory price alternatives have long been considered the two major choices for the pricing of a new product." Another source is,

Caferelli, E. J., *Developing New Products and Repositioning Mature Brands*, Wiley, 1980.

4. Many texts cover basic learning curve theory. For example, see Kaplan, R.S., *Advanced Management Accounting*, Prentice-Hall, 1982, pp. 97-105.

5. For greater detail see Womer, N.K., "Learning Curves, Production Rate and Program Costs," *Management Science*, April 25, 1979, pp. 312-319.

6. Learning curves have become so familiar to contractors that they are sometimes even used as part of the formal accounting system. A note on page 32 of the LTV Corporation's 1982 annual report reads, "Aerospace/defense contracts in progress are stated at accumulated costs...based on the estimated total cost of the contracts determined under the learning curve concept which is based on a predictable decrease in unit cost as production techniques become more efficient through repetition."

7. Wasson, C. B., *Dynamic Competitive Strategy & Product Life Cycles*, Challenge Books, 1974, p. 230.

8. One PM interviewed in obtaining background for this study stated that he would always prefer the penetration strategy. His reasoning was that if skimming were the choice the contractor might in fact not reduce the price as rapidly as you anticipate.

9. For a brief summary of the history and accomplishments of the Cost Accounting Standards Board see *Cummulative Progress Report to the Congress, 1971-1980*, U.S. Government Printing Office No. 341-843/341, 1980.

10. Please do not confuse the choice made for financial reporting with the method selected for tax purposes. Since there is no "booking requirement," there is no connection.

11. See CAS 411, *Accounting for Acquisition Costs of Material.*

12. For details of the methods see any appropriate text such as Welsch, G.A., Zlatkovich, C.T. and Harrison,W.T. Jr., *Intermediate Accounting*, 6th ed. Irwin, 1982.

13. DePuy, S.C., Jr., et al., *US Military Aircraft Cost Handbook*, TR-8203-1. Management Consulting & Research, Inc., 1983.

14. The procedure used attaches cardinal values to the method choices as though they were parametric. However, the underlying phenomena clearly are *not* parametric, and most certainly not linear. An alternative procedure would be to use categories and "dummy variables" or to use non-parametric statistical tests. These alternatives were explored with similar results. Cardinal scaling was chosen because it is probably more familiar to readers.

15. Significance levels and the standard error are calculated with reference to degrees of freedom, r-squared is not. Since two observations were dropped, the degrees of freedom declined from seven to five. The improvement in these particular statistics is therefore particularly impressive as there is actually less "evidence" available to the model, but the "randomness" of the sample has been destroyed. One could argue that this "improved" model is in fact invalid. Both are shown so the reader can decide.

Government Integrity in Contracting

A Message from the Secretary of Defense And the Inspector General

Contracting is big business in the Department of Defense today. Last year, we took over 14 million contract actions worth over $146 billion.

Every taxpayer wants to know that our Department is spending this vast sum wisely. To do so, our contractors must maintain the highest standards of integrity in their dealings with the government. The government must rely on the integrity of the contractor to provide us with the high-quality product or service for which we contracted.

We all know about the problems in government contracting. Cost mischarging, the substitution of inferior products and other fraud schemes have gone on in the past and will continue in the future unless we stop them. Our interest is in preventing these problems before they happen. The public and the government benefit most from prevention efforts.

In order to succeed, we need the help of all our managers and employees as well as those who are employed by our contractors. If everyone follows basic principles and ensures that others follow them as well, fraud will be eliminated from DOD contracts.■

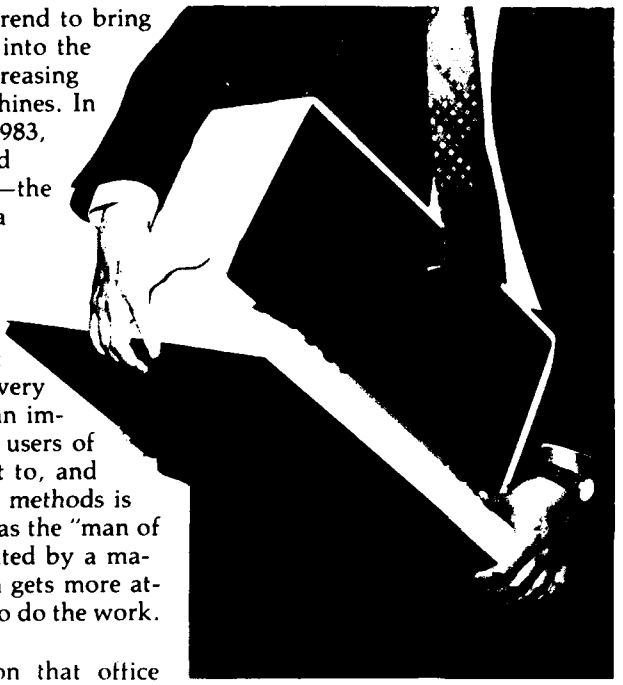
Technology Laboratory Leads in Anti-Corrosion Materials

The former U.S. Army Materials and Mechanics Research Center, Watertown, Mass., became the U.S. Army Materials Technology Laboratory (MTL), effective October 1. The name change is concurrent with the inception of the newly formed U.S. Army Laboratory Command (LABCOM), Adelphi, Md. The MTL, one of seven laboratories under LABCOM, conducts the Army's materials research and development program as designated by AMC and is the lead laboratory for materials, solid mechanics, lightweight armor, and materials testing technology. It leads in the development of corrosion-resistant and corrosion-proof materials.■

The Program Manager's Role in Implementing Office Automation

Major Michael F. Turner, USAF

The accelerating trend to bring new technology into the office has put increasing emphasis on machines. In its first issue of 1983, *Time* Magazine selected "machine of the year"—the computer—instead of a "man of the year." Managers are buying computers and word processors in record numbers in an attempt to get machines into every office. Yet, how to plan implementation and help users of the new systems adjust to, and accept, changing work methods is often overlooked. Just as the "man of the year" was represented by a machine, equipment often gets more attention than people who do the work.



Managers are buying computers and word processors in record numbers as they attempt to get the machines into every office

There is no question that office automation—use of data processing technology to create, process, store, and co..mmunicate information—can boost productivity of governmental office workers. Yet, in a special report about office automation and productivity, the General Accounting Office noted that the government's past experiences with individual application of both word and data processing demonstrated serious problems that might be repeated on a broader scale. The report noted that more specific attention to assisting user-level managers, developing systems, and assisting user implementation was necessary to improve productivity.[1]

Program managers who do not perceive needs of their military and civilian work forces when computer terminals and word processors are installed may find disruptions they did not anticipate. This is especially true as office automation extends beyond secretaries with word processors to officers and other professionals. Thomas Elliott, research manager for International Data Corporation's Office Automation Group said: "Assuming that the technology involved is relatively well understood, the technical results are unlikely to be major surprises. The effects of the new technology on the organization are much more likely to be unexpected."[2]

Why can't organizations bring technology into the office and expect users of new equipment to become instantly productive? Two major reasons are (1) the resistance to change rooted in old habits, and (2) the effort required to change working procedures and use new tools.

Resistance to Change Work Habits

Some managers fight for budget approval for terminals, an office information system, or a new dictation system, only to find the battle has just begun. High-ranking personnel won't spend time on a system they don't understand or perceive as value-oriented in their work. Thus, many may stick to old ways after the new equipment arrives. For example, a manager has a secretary take an 85-page report in shorthand for 2½ hours. The office had installed expensive, state-of-the-art dictation equipment in the word processing center 3 months earlier; the equipment was in, but users were not prepared to change old working methods.

Effort Vs. Benefits

Most managers know people are afraid of change. After all, office employees using computers sense the extra effort required for the following activities:

—Applying new work methods

—Training on the new system

—Redefining work arrangements and role interfaces of office personnel

—Tuning and adjusting the system

—Rewriting procedures and regulations

—Adjusting old personal work habits.

Office workers will accept change when the effort to change the above

activities is *less than* perceived potential benefits. The hypothesis below illustrates this:

If E ◄ PB, then C occurs where:

E = effort to change

PB = potential benefits of change (perceived)

C = change in work methods

Initially, most people probably perceive effort (E) in the above formula to be greater than the potential benefit (PB). If a change in technology results in actual benefits, office workers will likely welcome that change permanently. If users *do not* experience benefits, they may not perceive the potential of a new automated system and probably will revert to working as they did in the past.

In planning office automation, users' efforts must be minimal so that E does not exceed PB. How often does equipment get all of the attention, while people are an afterthought in the implementation? Marilyn Shinyeda, president of the Sierra Group, said the three most common problems of first-time office automation users are inadequate training, self-installation, and incorrect configuration.[3]

A successful implementation will address reasons people resist change and will emphasize enhanced training, carefully managed installation, and a system easy to use and configured to concentrate on users' needs in specific jobs.

The Air Force and Navy took great efforts to obtain large buys of equipment meeting high technical specifications at competitive prices. The Air Force standard small computer buy of the Zenith 100 series provided improved acquisition procedures, sharing of software and data files, and large purchases to save money. The Air Force considered vendor support in awarding its contract. The Army Materiel and Readiness command is purchasing a small computer in large numbers to save money and provide a common system for users. Even if the equipment has the technical potential to meet users' needs, users may blame the vendor (and the program manager) if the implementation planning fails. Of 125 *Fortune* 500 companies surveyed, 30 percent would not reselect the same vendor for their office automation equipment due to the "lack of vendor training and support."[4]

Obviously, then, users must receive sufficient support to recognize the value of new equipment—or the equipment is useless. How do program managers help their administrative people and professionals to recognize benefits of the new technology and learn how to apply it in their jobs?

Managing the Implementation

Management consultants like Peter Drucker and Rensis Likert continually remind executives to view people as a resource instead of a cost. It is easier to replace equipment than people; think of how hard it is to train *really* competent employees. Program managers need to educate themselves in the new technology to make good decisions about office automation; however, they will be more effective if they understand more about how their people react than how a computer operates. After all, managers outside of the data automation branch don't need to know all of the inner workings of a computer as much as what their organizational objectives and needs are. Many managers believe computers will provide the solutions to most organizational problems and will make decisions for them. In actuality, new computers may create new problems, especially during early implementation.

Top managers and their staffs can focus on several areas to ensure a successful implementation approach. The followng five elements, which are driven by people rather than technology, are especially essential to the early stages of implementation: (1) an implementation plan (not necessarily a strategic plan), (2) a good first impression, (3) a complete training program, (4) users' commitment and acceptance of new systems, and (5) promotion of tactics that promote system usage.

Implementation Plan

Some professionals are disenchanted because computer applications do not appear to meet their needs. Often, the implementation doesn't encourage system use. Why? James H. Carlisle, president of Office of the Future Inc., said: "What has typically happened with office automation is that people bring it in, they lay it down, and they just keep doing exactly what they did before. Typically, executives also don't dictate, they don't use the word processing center....It's business as usual and people wonder why productivity doesn't increase."[5]

The solution to this problem begins with an adequate implementation plan. Rather than worrying about the equipment and the numbers initially, concentrate on needs. Dr. Bret Charipper, consultant at IBM Corporation's National Accounts Division, said

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■ *Major Turner is the director of administration for the Air Force District of Washington headquartered at Bolling Air Force Base.*

Figure 1. EFFORTS VS. BENEFITS

If E◄ PB, then C occurs. If the effort (E) to change is less than the potential benefits (PB) as perceived by the new user, the users will more likely accept changes (C) in equipment and work methods.

EFFORT TO CHANGE (E)	POTENTIAL BENEFITS (PB)
Adjusting old work habits	Reducing manual tasks
Applying new methods	Decreasing interruptions
Training	Making revisions easier
Redefining work roles	Retrieving information more easily
Tuning the new system	Cutting turnaround time
Rewriting procedures	Distributing documents quickly
Installing equipment	Filing automatically
	Scheduling meetings easily
	Delegating more quickly

managers should ask users questions like these: "Who will be the initial users of the new system (target group)....For what tasks will they use the system....Who in the target group will be the key users (for example, who has the highest level of communication needs)....What changes must management make (such as, format changes or new data in the system) for the applications to be useful....What application training is required to make the implementation successful?"

People responsible for the implementation, who show a genuine interest in understanding jobs of potential users, can better determine who should have equipment and for what it should be used. Interviewing professionals beforehand will reveal their needs and attitudes, and provide insights into how much effort is required to help them adapt to new equipment and changing work methods.

Managers should plan carefully for the successful implementation of a new system rather than making the end-users "guinea pigs" who have to work out system problems. To keep users interested in a system's success, they must experience valuable benefits when first experiencing machines. The price of failure to plan—uninterested users who are not committed to use the system—is too great; recovery efforts will far exceed the effort to implement successfully at the start.

First Impressions Count

Managers implementing office systems will find it takes less effort to make a good first impression for users, than to overcome a bad one. For example, my office installed a new machine that failed for weeks to do a task successfully. Finally, the vendor replaced the machine; but, many were reluctant to re-try the machine because of the bad first impression.

The first impression *is* a lasting impression. A salesman visited my home, gave his pitch, and tried to pressure me. I wasn't sold but said I would call him back. He replied that if I couldn't decide on the spot, the company wouldn't allow him credit for the sale. I asked why, and the salesman said that if the initial impression is not good enough, a sale is almost never made. He was probably right, and his pressure tactics convinced me that my initial impression not to buy the product was the right one.

Managers will find it difficult to change the first impressions of clerical workers and professionals about new office systems. Since high usage of a new system is the measure of acceptance, managers cannot afford a poor implementation that discourages usage at the beginning. That's why it's better to lock equipment in a warehouse if there are "bugs" to work out, or if management doesn't have an adequate action plan for implementation. On the other hand, professional people achieving an initial benefit from office computers will attempt to discover new and innovative ways of doing their primary work.

Office workers will accept change when the effort to change to computers is less than the perceived potential benefits.

Training

Perhaps the most important part of a successful implementation plan is a complete training approach; in fact, training is the best way to sell a new office system to users. A mistake made in most training programs is to teach the operation of equipment first. To be successful, people who conduct training could follow this sequence:

Orientation Training—Educate users about the new equipemnt and its direct benefits *before* the system is installed.

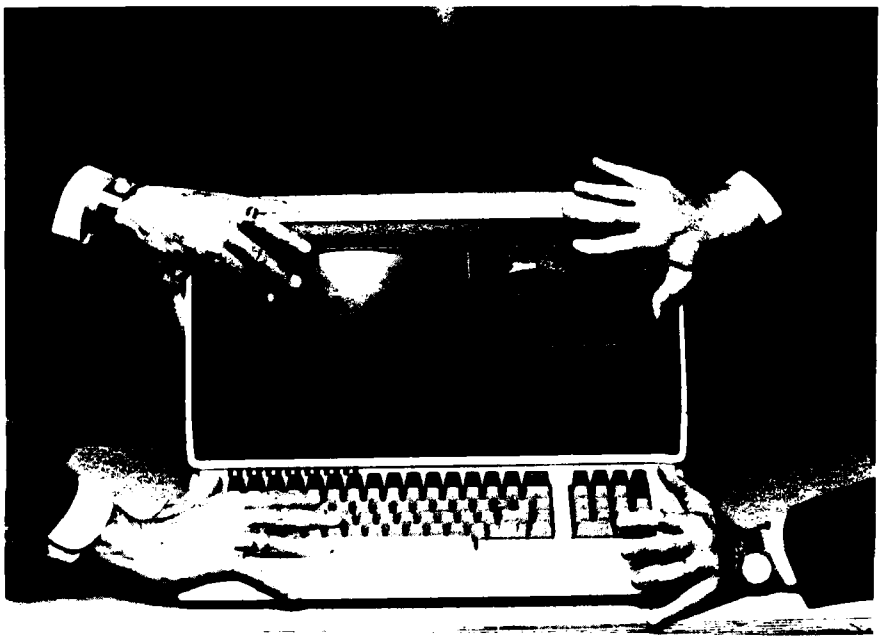
Application Training—Show users how the new machine will help them do jobs better. Conduct this training just before and just after new equipment is installed. Use a live demonstration of the equipment and apply it to user needs. Teach users the value of the system functions relative to their work, and discuss ideas of how they can use the system for specific needs.

Hands-on Training—At about the same time the equipment is installed, teach users to operate the equipment. Don't hand users a manual—invest in training, even if it costs extra. However, don't depend totally on the vendor for all training. Have on-line systems already installed in the users' work areas so they can use them after returning from training sessions.

Customized Training—After installation of equipment, teach users how to perform more specific applications important to each. Have a training coordinator available for follow-up training, to answer questions, and

to encourage system usage by providing individual assistance. Provide a local or toll-free telephone help-line.

Managers can overcome much resistance from users afraid to accept a new system if training follows this pattern. If trainers provide enough guidance so that users can begin immediately to perform useful applications, implementation will gain momentum. Employees want to know that usage is beneficial to them; therefore, teaching trivial uses will not convince them to accept major changes in daily working habits. Trainees will recognize if a new system provides a genuine payoff or value to their work, and will invest the effort to change old work methods.



What has typically happened with office automation is that people bring it in, they lay it down, and they just keep doing exactly what they did before.

User Acceptance and Commitment

As managers deal with "state of the art" technology versus the "why change?" syndrome, office workers must be convinced that the technology will improve the way they work. People will be encouraged to accept new office technology and to change work habits when management offers quality training, rewards and feedback, and commitment to improve. Organizations may need to alter criteria for selecting and hiring personnel to meet the new requirements.

No matter what management does, thousands of office workers in the Department of Defense have not used a computer terminal. To help them in the transition to office automation, managers need to guide the implementation carefully. With first-time users, it is important to get them involved in a new system implementation. Have user meetings before these systems are procured. Get them to contribute ideas to increase acceptance.

Managers have the main responsibility to help employees adjust to new office equipment. They need to get users involved in defining needs, selecting systems, and implementing changes. A wise manager will prepare users for possible future problems during implementation.

Once systems are installed, user attitudes must be considered, especially since new users may not feel comfortable with the equipment. If people installing and maintaining equipment do not ensure that systems are operating nearly all of the time, user acceptance and respect will be low. That is why reliability is essential and maintenance contracts are popular.

People sticking with the system until they become proficient will have difficulty going back to a lesser system. When the first word processors were installed in place of typewriters, many were skeptical. Now, management couldn't take the machines away!

Tactics to Promote Usage

There are tactics that promote the likelihood of system usage and acceptance. Where possible, *phasing in equipment* with small target groups is often more successful than a massive broad-scale implementation all at once. A popular theme with office automation consultants is implementing pilots in strategic locations in the organization until the desire for the new system becomes infectious. N. Dean Meyer, an office automation consultant from Ridgefield, Conn., advocates this tactic, encouraging pilots that "focus on the opinion leaders among the many potential user-managers."[6]

At first, usage will be low because many users will not recognize ways the system could pay off for them. When professionals are not familiar with a terminal, start with simple functions that have a quick and obvious result. Take one step at a time.

When several users have access to connected terminals, it becomes burdensome to communicate with those not on the system. This is why it is a good tactic to look at the communication channels (information flow) among people before deciding where to put new terminals. If only a few professionals who communicate often are on the system, they probably will not use the system often. However, when terminals become the primary device for communicating and transferring information, managers know they have begun to succeed in using office automation; just installing an isolated word processor in an office will not do that, even though it can help.

Personnel stability is important to implement office systems successfully, especially where several users are on a network. An organization with high turnover is not a prime candidate for a major change from the traditional of-

fice to the automated office. Users can't become proficient with the system unless they stay on the job. Usually, military and civilian professionals change jobs less frequently than clerical workers. At any rate, managers cannot afford to be constantly training a new user on the same machine.

Summary

The manager plays a primary role in guiding the implementation of office information systems. Managers must be convinced the equipment is reliable, people are committed, and that there is a likely payoff at the beginning of the implementation. Helping users accept new computers in their office requires the manager to understand the existing attitudes of the office staff. How people adjust is critical to system selection, design, and how often it is used. For example, when secretaries who receive new word processors gladly give up the old typewriters, managers may see that as a positive signal of successful implementation. Since equipment won't make much difference in the office unless the users accept it, managers need to pay as much attention to helping all of the users adapt, especially those who are skeptical, as they do to the technology itself.

No technology will bring about desired results, unless management boldly and creatively leads the office in a thorough planning and implementation effort which addresses the needs of all office workers, including officers and professionals. Many organizations always seem to be planning the technical addition and installation of equipment, when the greatest challenge may be linking the use of technology to organizational objectives, work methods, and information needs. Office automation will be fully successful when people are not forgotten in the preparation for new office systems, and that is when technology will change the office.■

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Pentagon Making Major Effort to Plug Security Leaks

"...from our standpoint, even one case is too many."

When 16 million classified documents get handled each year by 4.3 million DOD military and civilian employees and contractors, how do you make sure they don't fall into the wrong hands?

It's this "needle in the haystack" problem DOD is working to overcome, L. Britt Snider, DOD principal director for counterintelligence and security policy told the Congress.

Snider said the Pentagon has made a major effort to plug up security leaks. But still DOD receives about 600 reports a year concerning contacts hostile intelligence services make with DOD personnel, Snider said. There are occasional instances where DOD employees and contractors themselves initiate these contracts and offer to sell classified information to which they have access.

Snider conceded that when compared to the vast numbers of cleared people, the number who participate in, or initiate, espionage activities is "infinitesimally small.

"But it is equally true that one person with the right access may be capable of compromising military systems that cost the United States literally millions, if not billions, of dollars to develop and produce," he said.

"This may lead to actions to counter the latest U.S. military hardware or the latest U.S. strategy. And so, from our standpoint, even one case is too many."

Snider outlined DOD's plan for confronting the problem:

Controlling access. Secretary of Defense Caspar W. Weinberger recently announced plans to slash the number of security clearances within DOD by 10 percent by Oct. 1. "Obviously, the object is to accomplish the defense mission with as few cleared people as necessary," Snider said.

More accountability. Weinberger's plan calls for improved classified document control, but just as importantly, better controls over individuals with access to classified information. Meanwhile, the DOD Hotline and periodic security inspections are creating more awareness about security violations.

Better enforcement. The DOD is looking at ways to improve its investigative process before granting clearances, and already conducts comprehensive reinvestigations of those with access to particularly sensitive information. Additionally, each service's counterintelligence investigative agency, the Federal Bureau of Investigation, and the Central Intelligence Agency have stepped up cooperative efforts to police security violations.

"We nonetheless must face the ultimate reality that no matter what we do there will be other espionage cases in the years to come—perhaps not as many; perhaps not as serious; hopefully not as drawn out, as those which have recently come to light, but there will be other cases," Snider said.

"It is the challenge for all of us in this area to minimize their occurrence within the limits of our resources and consistent with the values and principles of a free society."■

THE TIME IS NOW!

Evolutionary Acquisition of Command and Control Systems

Edward Hirsch

The most controversial topic in U.S. strategic defense today is the Strategic Defense Initiative (SDI).

The public debate of this issue largely conducted in the news media and in Congress, has to do with the effectiveness and propriety of SDI. A less public but equally important debate, taking place within the Department of Defense (DOD), concerns the Command and Control (C^2) to be applied to this complex system of systems.

Certainly, the details of the total C^2 systems have not yet been identified, but just as certainly, the methodology by which these details will be illuminated and specified *is* clear. They will evolve -- even as the SDI itself evolves.

The Commander (the user) will present his requirements to the developer on a *continuing basis as they evolve*. Initial and subsequent increments of operational capability will be defined, refined, funded, developed, tested and fielded with continual input from and evaluation by the user. There will be no "firm user requirement" laid on the developer, followed by a hands-off attitude while the developer builds something the user no longer wants by the time he gets it. Neither the user nor the developer can state now with certainty and engineering specificity what one needs and the other can produce. Yet this will not keep us from proceeding down the development path.

National priority and urgency will provide impetus to the program; however, no new acquisition policies will have to be developed, staffed and published to permit the application of a "non-traditional" evolutionary acquisition strategy. Not only is existing OSD policy sufficiently flexible to *permit* the innovative use of an evolving requirement, it actually *encourages* it.

The Office of Management and Budget (OMB), in Circular A-109, requires that the acquisition strategy for a new system be uniquely tailored for that program. The flexibility implied by that requirement is further enunciated by Department of Defense (DOD) in its 5000 series of directives and instructions; specifically, in DODD 5000.1, Major Systems Acquisitions, dated 29 March 1982, which states:

> "A. Tailoring and Flexibility. The acquisition strategy developed for each major system acquisition shall consider the unique circumstances of individual programs. Programs shall be executed with innovation and common sense. To this end, the flexibility inherent in this directive shall be used to tailor an acquisition strategy to accommodate the unique aspects of a particular program as long as the strategy remains consistent with the basic logic for system acquisition problem-solving and the principles in this Directive for business and management considerations . . . ."

From this guidance flows the authority -- yes, and direction -- to be innovative in developing acquisition strategy.

Within the C^2 world, the need is great for initiatives, imagination and innovative thinking in developing acquisition strategies that result in useful equipment fielded in a timely and cost-reasonable manner. We simply have not done too well in the past.

We have, of course, studied this problem. And studied it, and studied it, and studied it. Among the studies, two in my judgment, dominate. The first was the study conducted by the Defense Science Board (DSB) Task Force on "Command and Control Systems Management," completed in July 1978. Among other important conclusions, the study group identified the need for adaptability to user needs and for their evolutionary change over time.

In July 1981, the Armed Forces Communications and Electronics Association (AFCEA) initiated the one year effort that is still pre-eminent in the field, "Command and Control (C^2) System Acquisition Study." The credentials of the study group members are unassailable and impressive, the research effort formidable, the arguments articulately and lucidly presented, the logic of its conclusions compelling and the recommendations sound. BUT -- apparently not much has happened to implement its recommendations since the effort was completed nearly three years ago. This does *not* mean that all of the study's results have been rejected or repudiated. Benign neglect rather than active rejection has been the fate of the study report. It deserves better.

The conceptualization and exposition of the notion of Evolutionary Acquisition (EA) in the study report has (consciously or otherwise) influenced the acquisition strategy of some C^2 systems now in development—not enough, but some. I have re-examined EA as defined and postulated by the study group and am presenting it here in a somewhat modified fashion with the hope of accelerating its conscious and positive acceptance and use within and by the C^2 acquisition community.

EA is an adaptive and incremental strategy specifically developed for C^2 systems acquisition. It requires:

- A general functional description of the total overall capability desired.
- A short requirements statement.

- A flexible architecture permitting accomplishment of evolutionary change with minimum redesign.
- A plan for evolution that leads toward the desired capability.
- Early fielding of an initial basic (core) operational capability.
- Subsequent increments of capability defined, funded, developed and fielded.
- Provisions for utilizing continuous user, developer, and tester feedback.

Let it be clear that EA is not:

- A single strategy ready for application in any C^2 system acquisition effort.
- A checklist approach that will greatly simplify C^2 systems acquisition.
- Thoroughly understood nor similarly perceived by either its proponents or skeptics.
- An approach that provides Carte Blanche for an unbridled budget.

The EA approach requires a need statement which includes a clear description of the desired overall capability. This need statement in no way implies the need to develop that complete and detailed system description so common in current system acquisition documentation. The system description may even be qualitative as long as it provides an overall framework which states desired functional characteristics. The system description, in addition to the architectural framework within which the system will evolve, constitutes the system statement of need.

A concept called the core element is derived from the need statement. It defines a capability that:
—will significantly enhance the users ability to perform his mission
—can be quickly fielded.

Core element definition results from combined user-developer effort. This kind of effort is a principal characteristic of the EA approach. It:
—continues throughout the system life cycle in order to develop and update system requirements
—provides that essential feedback from user to developer which is an integral part of the evolutionary process.

During core element testing, and even after portions of the system are fielded, the user continues to support an ongoing system evaluation, providing inputs from his unique perspective. Essentially, system operational characteristics are:
—established by the user in coordination with the developer
—fielded as functional capabilities in the form of testable elements (the first of which is the core element)
—tested with the assistance and deep involvement of the user.

Incremental system growth beyond the core element is governed by an evolutionary plan which provides for the development of additional system increments. The plan requires flexibility to accommodate continuing performance update from the developer-user-tester team as they test and assess system operational use. The plan is essentially a baseline from which deviations are made as dictated by the results of continuing feedback from tests and assessment of operational use.

Within the C^2 world, the need is great for initiatives, imagination and innovative thinking.

Figure 1 represents graphically an EA model and its application over time. The model emphasizes the incremental nature of the EA approach and the need for continual user involvement in every phase of development.

- The user begins the process when he defines the overall system requirement in general, functional terms. At this time, he also defines as specifically as he can precise functional requirements for the first system element to be fielded (the core element). When fielded, the core element must provide a significant, identifiable operational capability.
- User and developer formulate an overall system concept and generalized capability. The developer provides a preliminary flexible systems architecture capable of accommodating system evolution with minimum system redesign. The arhitecture is stated generally without the high degree of specificity "usually" required.
- The evolutionary development plan is a joint product of the developer and the user. Its goal is achievement of the overall capability through incremental development and fielding of individual modules of operational capability.
- The developer, with continuing user input, defines, funds, and develops the initial (Core) capability. Significantly, the Core element is not fielded until both tester and user have determined its acceptability. The incremental capability is exercised and evaluated by the user in his operational environment. The user provides continuous operational performance data to the developer.
- User and tester input is the essential ingredient for definition, funding and development of additional incremental operational capabilities. Figure 1 indicates the necessary sequence of activities to implement the evolutionary plan and to modify it as required by operational necessity and experience.

In the interest of simplicity, the model does not present the contribution that an Off-Line Development, Test and Support Facility can make to the development process. Such a facility, utilizing operational mock-ups, simulations and a software laboratory can facilitate the developer's efforts to integrate the user and tester inputs with his development activities. It also provides the capability to generate and evaluate hardware and software up-dates.

The model -- admittedly -- is an overly simplistic presentation of a complex set of procedures; procedures that require active acceptance and action by bureaucratic entities intent upon doing the best job they can within narrow perceived constraints. Which takes us to the root of the problem. It is my view that the constraints upon freedom of action by acquisition managers and participants are more

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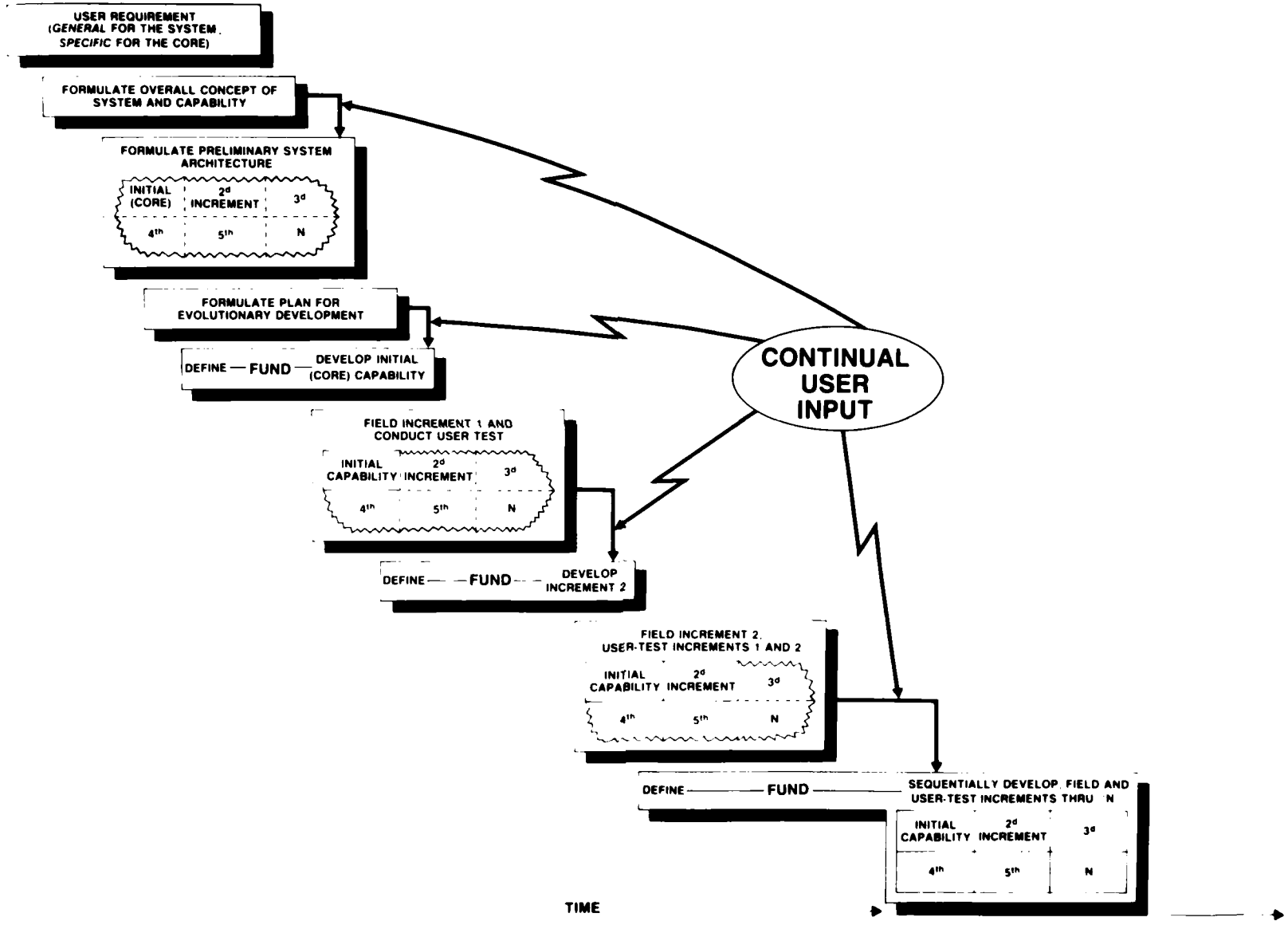
Figure 1. EA: Incrementally Define, Fund, Develop, Field and User-Test The Operational Capability to Satisfy the Evolving Requirement



imagined than real; more self-imposed than mandated. Here, as well, is where my support for some of the AFCEA study groups recommendations falls off. The group, among other recommendations, urged that OSD mandate EA as policy, that it change DOD policy and procedures and recognize the special needs of C^2 systems.

We need no change in OSD policy; no additional OSD guidance; no increased centralization of authority or direction; no increase in the level of management; and assuredly no OSD EA Advocate General. What we *do* need is the commitment and support of acquisition participants throughout DOD. Not just OSD, but the Services as well. We do need an increased sense of awareness among our PM's that they *already* have all the authority they need to use this approach *now*. We must work within the bounds and limits actually stated -- not implied or inferred -- by the system. The system will support our actions. As noted above, current OSD policy encourages the application of an EA approach to C^2 systems acquisiton.

Specifically, DODI 5000.2, Major System Acquisition Procedures, dated 8 March 1983, identifies 39 "Acquisition Management and System Design Principles" and states that "the following principles shall be considered in planning major system acquisitions." Among these principles, the following is included:

> "Evolutionary Development and Acquisition of Command and Control Systems.[1]"

The footnote identified by [1] references Defense Acquisition Circular 76-43, Acquisition Management and System Design Principles, dated 28 February 1983, which provides a discussion of Evolutionary Acquisition and other acquisition management principles. The circular was published as information guidance, not a substitute for regulations, directives or instructions. It provides a brief description of the characteristics of C^2 systems that may require an EA approach and discusses that approach in general terms. Key excerpts are shown in Figure 2.

I believe OSD has done everything it should do to encourage our use of an EA approach. Now the decision rests squarely and appropriately with the Services. The action, if there is to be any, to increase use of EA must be generated at the DOD component -- our Army, Navy and Air Force. It is here that expanded application of the EA approach should be "urged" because it can expedite the introduction of C^2 systems into the Services. Acquisition managers (not only Program Managers) should consider the use of EA during the development of the acquisition strategy for every C^2 system. Then, when an EA option is selected and approved, every acquisition manager must take positive measures to ensure that all personnel actively and aggressively exercise imagination and initiative to support the acquisition effort—particularly in those areas where deviations from the "traditional" procedures are indicated.

Figure 2. Command and Control² Systems

a. The types of systems that augment the decision-making and decision executing functions of operational commanders and their staffs in the performance of C^2 require a tailored acquisition strategy. The principal characteristics of such systems are: (1) acquisition cost normally is software dominated; (2) the system is highly interactive with the actual mission users and is highly dependent on the specific doctrine, procedures, threat, geographic constraints, and mission scenarios of these users; and (3) these systems are characterized by complex and frequently changing internal and external interfaces at multiple organizational levels, some of which may be inter-Service and multinational.

b. The use of pre-planned product improvement (P^3I) is a procedure highly appropriate to such systems and should be considered when appropriate. C^2 systems generally require an evolutionary acquisition approach. This is an adaptive, incremental approach where a relatively quickly fieldable "core" (an essential increment in operational capability) is acquired initially. This approach also includes with the definition of the "core capability"; (1) a description of the overall capability desired; (2) an architectural framework where evolution can occur with minimum subsequent redesign; and (3) a plan for evolution that leads towards the desired capability.

c. Programming, budget approval, and acquisition management must be tailored to encourage and enable early implementation and field evaluation of a "core" system. Subsequent increments must be based on continuing feedback from operational use, testing in the operational environment, evaluation and (in some cases) application of new technology. Operational and interface requirements and operational utility criteria should be evolved with the participation of actual mission users (or lead user and appropriate surrogate for multi-user systems). There must be regular and continual interaction with developers, independent testers, and logisticians.

d. The user will support the independent T&E agency in determining readiness for operational use of the "core" system and work closely with the development activity and independent tester in evaluating subsequent increments of new technology. A centralized facility will be used to accomplish post deployment software support of fielded increments under centralized configuration management. Consideration must be given to the use of existing commercial equipment, related system software and firmware, and contractor maintenance (with warranties) whenever logistic, interoperability, readiness considerations, and field conditions permit it.

e. Those elements of C^2 systems that must survive and endure in strategic or theater nuclear warfare will be at least as survivable as the weapon system they directly or indirectly support. A proper mix of survivability techniques must be applied. Existing military and commercial hardware, software, and procedures should be used only if it can be demonstrated that they can be protected against and made resistant to wide-area threats such as jamming, spoofing and electromagnetic pulse, and that they can provide reasonable functional/system/path redundancy against direct attack and sabotage. Interoperability and battlefield sustainability will be key considerations.

f. The procedures described above are equally applicable to similar non-major C^2 systems as well as counter - C^3, electromagnetic countermeasures, and electronic warfare systems."

We know that a "can-do, will-do" philosophy will be applied to make the SDI program go; we can make it happen for C^2 programs if we get moving and rid ourselves of self-imposed, artificial, constraints on our initiatives.

The logic is clear and unambiguous:

- A major strategic initiative, which relies for its effectiveness upon a complex C^2 system, will apply EA concepts to its acquisition strategy.
- Existing OSD policy is flexible enough to accommodate EA.
- Rigid adherence to the so-called traditional approach to C^2 systems acquisition has not served us well.
- We have all the authority we need to expand the use of EA *now*.
- Our Service components should generate the actions required to encourage the use of EA and direct that acquisition participants actively help make it work. ■

■ *Mr. Hirsch is a professor of systems acquisition management, Department of Research and Information, at DSMC.*

Pocket-Size Camouflage

A new "pocket-sized" camouflage net being developed by the Army Troop Support Command's Belvoir R&D Center was used successfully in Korea during Exercise Team Spirit 85.

The individual concealment cover (ICC) is a solid-colored 5-foot by 7-foot net made of incised, coated nylon. Each unit weighs less than a pound and can be folded to fit in the pocket of a soldier's uniform. The net can be joined together to form a larger cover. In the field, they can be used for concealing fighting positions, weapons emplacements and soldiers. During Exercise Team Spirit, the ICC was used by elements of the 7th Light Infantry Division for concealment.

The ICC is being developed under a quick response program at the request of the 9th Infantry Division and the Army Development and Engineering Agency (ADEA).

Camouflage is one of 18 fields of endeavor pursued by the R&D Center at Fort Belvoir. ■

Field Kit Adds Mine-Clearer

The Troop Support Command's Belvoir R&D Center has awarded a contract to General Dynamics, Land Systems Division in Warren, Mich., for the development and testing of an adapter kit that will allow the Army's recently fielded track-width mine clearing roller to be mounted on the M-1 Abrams tank.

The roller, also developed by the Center, weighs about nine tons and consists of two wheel assemblies which are mounted in front of the tank's tracks to clear pressure fused mines. A weight drag on a chain between the two assemblies is used to clear tilt rod mines. In operation, the adapter kit will be attached to the tank's towing eyes. Not only will it allow the roller to be mounted on an unmodified tank in the field, the driver can use it to disconnect the roller from inside the tank in less than 15 seconds. This quick-release mechanism will enable him to continue the mission without the roller once the minefield has been breached.

Three prototype adapter kits will be built and tested under this contract, which is expected to be completed next summer.

The Belvoir R&D Center is part of the Army's Troop Support Command. Its 1,200 military and civilian personnel are responsible for development of military equipment in some 20 areas related to battlefield mobility/countermobility, survivability, energy and logistics. ■

Whenever in this publication "man," "men," or their related pronouns appear, either as words or parts of words (other than with obvious reference to named male individuals), they have been used for literary purposes and are meant in their generic sense. ■

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Beyond Clausewitz...

As a king's military mentor, his classic treatise focused on winning battles instead of wars.

Douglas M. McCabe

I enjoy asking tricky questions. When I ask whether the Principles of War apply today, the proper response must be that principles—any and all principles by their very nature, in all phases of human life—are eternal, that only the details of their application to different circumstances vary; therefore, most assuredly the principles of war are applicable today.

At least up to and through World War II, the Principles of War were deemed to be inviolable. I do know that Clausewitz's classic enunciation of the principles was a textbook at the Cavalry School, Fort Riley, Kan., in the 1930s.

In my opinion, Karl von Clausewitz did not enunciate *all* the principles, and I think I understand the reason. He was a general on the staff of, and, more importantly, the military mentor of King Frederick William III of Prussia (reigned 1797-1840). Clausewitz wrote his classic treatise for the personal instruction of the king—and therefore probably with only the needs of the king in mind. That is: In the circumstances in which the king sallied into battle, only tactics (winning of battles), and not strategy (winning of wars), was a major concern. It is interesting that Clausewitz suffered frustration from never having an opportunity personally to demonstrate his principles by leading the Prussian army into battle; had he done so, that battle undoubtedly would be a classic in the same sense that the last battle of the Civil War, Sheridan's defeat of Lee at Five Forks, was a classic example of professional perfection.

Editor's Note:

On War, by Karl von Clausewitz, published in 1832 and translated into English in 1908, is a prolific distillation of the lessons of war to that time, and was the Continent's main source of military science.

My defeat by Sheridan at Five Forks was a classic example of professional perfection.

The Principles of War

I want to review briefly most of Clausewitz's principles and, then, discuss principles he did not mention.

SURPRISE: I mention this first because it is the most powerful weapon in the arsenal of military science. It tremendously increases the power of an attack, especially when the attacker has the weaker force. One has only to recall Washington's surprise of the British by crossing the Delaware; any one of many Civil War battles; the American calamity at Pearl Harbor; nervous guesses of the Germans regarding where Eisenhower would strike the French coast. Surprise is, of course, a two-way street. Surprise the enemy without letting him surprise you is a situation the Confederacy's "Jeb" Stuart illustrated in his order on the road to Gettysburg to his cavalry commander, Robertson, on June 24, 1863: "Your object will be to watch the enemy, *deceive him* as to our designs, and harass his rear if you find he is retiring....In case of an advance of the enemy you will...*discover his intention.*" [emphasis added]

The last part of Stuart's order was dangerous. It is my understanding that, in the 19th Century, American commanders, before battles, made an estimate of the situation, which included determination of the enemy's intentions; although a clever enemy, especially Lee, would pretend to reveal his intentions and then, using the Principle of Surprise, ungenerously do something else. Later, the format of the estimate was changed to reveal only what the enemy *could* do, especially the worst he could do, leaving his actual intentions undecided in order to avoid being surprised. Surprisingly (no pun intended), Lee did not use his most powerful weapon on the third and decisive day at Gettysburg. In a council-of-war the previous night, Meade told Gibbon, who was situated in the center of the Union line, that Lee, having failed in attacks on the Union right and left, would hit the center on the third day, and that is where Lee, although he was a master of the Principle of Surprise, sent Pickett's ill-fated troops.

THE OBJECTIVE: The ultimate purpose for which a battle or a war is fought must be the correct one. Lincoln properly defined his purpose in the Civil War as being the prevention of the dismemberment of the Union (while also determining that it should be the end of slavery). But President Truman, faced with Korea, and President Johnson, faced with Vietnam, chose limited objectives short of victory, with disastrous consequences to the morale of the American troops and American people. Meade made the same mistake at Gettyburg, selecting as his objective the stopping of Lee's invasion of the North. His proper objective was the annihilation of Lee's army, as Lincoln incessantly and frustratingly told his generals.

PURSUIT: Although Clausewitz did not include this in Principles of War, it should be mentioned in connection with Gettyburg. That 3-day battle left both armies exhausted, except that Meade's reserve Sixth Corps, 15 percent of his army, was fresh, not having been used. But, everything considered, Meade cautiously decided that his army was too tired for pursuit of Lee in the latter's pathetic retreat on the fourth day at Gettyburg. However, Grant stated in his *Memoirs* that, had either of his two most competent subordinates, Sherman and Sheridan (and the name of Thomas should be added, to give recognition to Lincoln's four best men), been at Gettyburg, they would have used the Principle of Pursuit to end the war right there. What do you think would have been the reply of Meade's exhausted men if he let them decide whether to pursue Lee or permit him to escape and have to meet him again in future battles when he had recovered his strength? I would hate to believe they would have decided to spend the few days catching up with their sleep, with Lincoln being disgusted that there was no pursuit. If an army is defeated but retains the ability to retreat, it is only the Principle of Pursuit that can annihilate it and thus fulfill the Principle of the Objective.

ACCOMPLISHMENT OF THE MISSION: This is one of Clausewitz's principles, and it is implied in the previous discussion. It means not only having the correct objective but also determinedly working to achieve it. Stuart violated this principle in the week before Gettysburg. His mission was to use his cavalry as Lee's eyes in determining the strength and disposition of the Union army. But, in total disregard thereof, Stuart galloped off on his own improper authority in an absurd ride around the rear of the Union's advancing forces, leaving Lee in such a state of blind uncertainty that he was unable to follow the customary practice of choosing when and where to engage in battle. (The two armies collided accidentally at Gettysburg.)

CONCENTRATION OF MASS: The focusing of preponderant power at a decisive point in a battle area was exemplified by the Germans at the Battle of the Bulge. McClellan, on the other hand, kept his Fifth Corps unused at the critical moment at Antietam in the fall of 1862, thereby losing his opportunity to destroy Lee. McClellan's explanation was that he did not deem it prudent to use his reserve. It is obvious that a corollary of concentration of mass is the Principle of the Reserve, having one, and *using it* at the critical moment.

Mao-Tse-tung was a master of concentration of mass in the guerrilla warfare of his small army against the

McClellan's pursuit at Antietam would have defeated Lee.

Gen. U.S. Grant

Chinese government. His definition of guerrilla warfare is classic: "In the war, the few against the many, but in the battle the many against the few." In other words, fight a battle when you can outnumber an isolated contingent of the enemy's forces. Grant, outnumbered, fought half a dozen such minibattles on his way to Vicksburg, avoiding a general engagement.

ECONOMY OF FORCE: Clausewitz would shudder at the idea of sending a battleship to do a destroyer's job (no more need be said regarding this Principle).

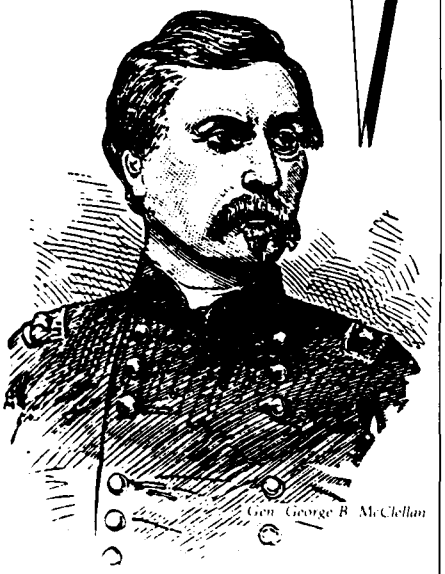
Attention should now be turned from Clausewitz's Principles of War and corollary principles derived from them to the question of whether there are other principles of war. Specifically, should attack, cooperation, unity of command, task force, and mobility be so designated?

ATTACK: Man is not like a vicious animal, which instinctively bites and kills every living thing coming within its reach. Rather, man is normally aroused to attack only in a situation of self-defense, and then only to the degree of intensity required. (This discussion is not about those few men, such as Alexander the Great, Genghis Khan, and Napoleon, who, having an army at their disposal, use it for their own glory and benefit.) The point is that a solider, or a commander of soldiers, is temperamentally inclined not to shoot until he is shot at. McClellan had that temperament to an excessive degree, and Lincoln waited too long before firing him. McClellan had been the chief engineer, and a superb one, of the Illinois Central Railroad before the Civil War. McClellan's railroad associates knew a quirk in his nature that Lincoln learned the hard way: Whenever he completed a bridge, he was fearful of giving the order to send the first train over it.

Sheridan was the opposite of McClellan and the "tightingest" general of the Civil War. He was its Billy Martin, small and pugnacious. Sheridan's private fights with West Point classmates would have denied him a commission had not a professor commented that "if there should be a war, he will be a good man to have around." When Sheridan commanded the Army of the Shenandoah he was 5'4" in height, weighed 135 lbs. and was 33 years old. Lincoln told him undiplomatically that he was decidedly small and young for such a job. Sheridan fought karate style. The essence of karate is not the types of blows or the kinds of damage inflicted; on the contrary, it is merely something in which Sheridan excelled—swift, rapid-fire, staccato hits, each delivered before the opponent has recovered balance from the previous one.

Confederate generals learned that to attack Sheridan was to invite an instantaneous counterattack. Early made his attack at the Battle of Cedar Creek on October 19, 1863, and, during a heavy fog at dawn, reduced Sheridan's army to a state of utter disorganization. It was routed, with a large portion of it fleeing precipitously. Sheridan, returning from Washington, had spent the night 20 miles away. Hearing the sound of battle, he began his famous gallop. What do you think Sheridan would do when he found his army smashed? Most generals would

But I didn't think it prudent to use my Reserve.



Gen. George B. McClellan

content themselves with leading it to a safe place to lick it wounds. When Sheridan met the acting commander, Tolbert, the latter, unable to stop the retreat, made what was probably the understatement of the Civil War: "I'm glad you're here!" But, before meeting Tolbert, Sheridan encountered the vanguard of the retreat, and rising in his stirrups and waving his hat (a statue on Sheridan Road in Chicago depicts the scene) shouted: "Boys, we're going back!" Groans turned to cheers! What magic did Sheridan have that Tolbert lacked? Every ounce of Sheridan's blood exuded leadership, and we must call it a Principle of War because it converts cowards into heroes. Sheridan encountered his fleeing troops at midday and spent a couple of hours in reorganization. Then, a gallant army in blue, reborn after the morning's defeat, rose and shook itself convulsively as the will-to-win surged once again, and went back! It went

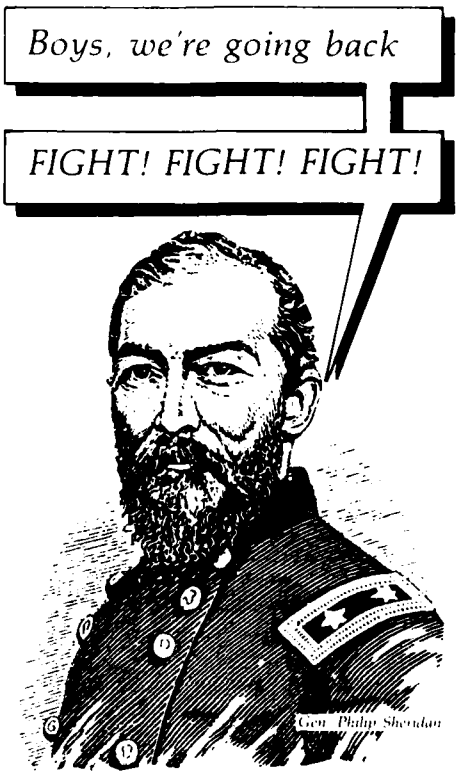
back to cleanse from its banners the shame of having run away and to destroy Early's gallant army with mighty, cadenced, irresistible blows before the setting of the same day's sun. After the Civil War, a participant wrote an article summing up the principle that Sheridan had demonstrated in a cogent phrase: "Fight! Fight! Fight!"

Something should be said about the will-to-win. Military experts note that it is not necessary to destroy an enemy *physically;* it suffices to quash his will-to-win *psychologically,* whereupon he waves the white flag. That is surely the lesson of Vietnam (although it was not the enemy who did that to us). Early's failure was to destroy Sheridan's exuberant will-to-win. In the last analysis, the Battle of Cedar Creek was not a physical clash of armies. It was psychological warfare testing which of two men had the stronger will-to-win after Early had boasted publicly that he would destroy Sheridan.

"Attack! Attack! Attack!" That is the way it was phrased by Foch (generalissimo of the Allied Forces in World War I) while he was an instructor at the French military academy, at the same time kicking viciously and staccato-like with his booted leg at an imaginary enemy. Later, in World War I, a French general (perhaps Petain) sent a telegram to Paris in approximately the following words: "My left retreats. My center is precarious. My right is collapsed. I attack immediately." And then, of course, there is our navy's John Paul Jones standing on his sinking ship. "Do I understand," his opponent shouted, "that you have surrendered?" Jones' immortal reply: "I have not yet begun to fight!" And minutes later it was his opponent who surrendered.

I submit that attack is one of the eternal Principles of War. The word means much more than a physical act. It is basically a mental attitude, ideally one professionally conditioned between the extremes of timidity and rashness, a mental attitude of attacking instinctively at every reasonable opportunity.

Is cooperation (voluntary joint action by two independent commanders without orders from a common higher command) a Principle of War? Clausewitz did not mention it, but the British taught it as such at least through World War II. During World War I, while Britain's Allenby was fighting what has been called, with medieval history in mind, the "last crusade" to free Palestine from Turkish control, an independent British force passed close by. Allenby asked for its cooperation, with its commander replying: "I am on a special mission, but I will do what I can." Grant at Donelson, Shiloh, and Vicksburg had superb cooperation by the Navy's gunboats on the Tennessee, Cumberland, and Mississippi rivers. We should never forget that Washington would have failed, and perhaps lost our independence, at Yorktown had not Admiral de Grasse not only used his personal fortune to pay Washington's disgruntled American and French troops, but used his fleet to prevent a British fleet from carrying off the British forces at Yorktown, in direct disobedience of his orders from Paris to fight the British only in the Caribbean.



But is cooperation sufficient? I insist that only unity of command, which I discuss later, is adequate. Cooperation requires a special breed of fighting men willing to stake their military reputations on a voluntary action which, for all they know, may ruin their careers. It is well known that Montgomery was temperamentally disinclined to cooperate with Eisenhower even though, previously, Montgomery had invoked the British concept of cooperation at the start of his campaign against Rommel in Egypt by asking for, and receiving, the support of the British navy.

In World War I, France believed that its officers and generals had a proper cooperative spirit in the sense of individual initiative, with the army's field service regulations stipulating that a local commander would obey not the order he received but the order he reasoned he would have received if his superior had properly understood the local situation. The granting of maximum freedom of action to local commanders exemplifies the Principle of Subsidiarity, the handling of a problem at the lowest possible level in the chain of command, where the heart of a problem is best understood, a situation which facilitates accomplishment of the mission. But, regarding cooperation, there was an incident in the Civil War when a hard-pressed Union general asked for the assistance of another general whose nearby troops were idle, only to be told: "Sorry. I do not have orders to assist you."

I prefer another Civil War incident. At Chicamauga, Thomas acting as the rear guard of the Union retreat, had told Granger, one of his subordinates, to stay in reserve and await orders. The sound of the battle disturbed Granger's trained ears, and he cried out: "Thomas needs me!" Today, if you visit the battle museum at Chicamauga you will see what may be the most inspiring photograph of the Civil War. Beneath it is this statement: "Major General Stewart Granger marching without orders toward the sound of battle."

Not every man in uniform is a Granger and, human nature being as it is, cooperation has a weakness

Cooperation from the French Admiral de Grasse, who disobeyed orders from Paris, saved us not only at Yorktown, but helped win the war.

Gen. George Washington

disparaging its elevation to a Principle of War. If it so designated, it should be secondary to the desideratum of unity of command.

TASK FORCE: Clausewitz did not mention this type of military organization. A task force is a military unit specially designed for a particular mission. An ancient example is Carthage's Hannibal in the 2nd Century B.C. marching around the Mediterranean, through Spain, and across the Alps with elephants, to attack Rome. Modern Germany was adept at designing task forces. When a German commander was given a mission, he personally designed the organization he wanted, asking for and receiving (if available) the types of subordinate units and equipment he designated. Germany, like France, definitely subscribed to the Principle of Accomplishment of the Mission. Admiral Halsey, the American Task Force commander in the South Pacific, had subordinate units of Navy, Army, Marine, and Air personnel. Intolerant of their pride of service, and noting khaki uniforms designated their services particularly by the color of their neckties, Halsey ordered the neckties removed. He declared that, if all those services would not think and act as a single unit, he would impress that Task Force necessity on them by stamping "South Pacific Fighting Force" on the seats of their pants! I submit that task force is a Principle of War, as a corollary of Accomplishment of the Mission.

UNITY OF COMMAND: I have held this for delayed consideration for a particular reason pertaining to America's defense. Clausewitz did not mention it. That is not surprising because it is obvious that his king, for whose personal military education Clausewitz enumerated Principles of War, would, in an age of royal depotism, instinctively exercise unity of command when leading Prussia in war, without Clausewitz having to give any thought to the matter, much less to assign a name to it. Unity of Command means the control of a military operation by a single mind instead of the commanders of all its units having to rely on the inefficiency of cooperation.

Grant exercised unity of comand over all of Lincoln's far-flung armies, but not over the Navy and its Marines. If unity of command is a Principle of War, Lincoln violated it by not placing Grant over the Navy, which was involved in the support of Grant's armies and his overall strategy for winning the war. The fact that Lincoln would have found that to be a political impossibility does not change the situation if unity of command is a Principle of War. Politics is subordinate to principles, not vice versa. It is interesting that Lee had authority to command (and to surrender) only his own Army of Northern Virginia, and not the other Confederate armies, in contrast with Grant's status. At the Battle of the Argonne, Marines did not "cooperate" with Pershing and they were under his command. It is significant that the Coast Guard, an independent command with it own service school, supervised by the Secretary of

You can have the Army, Grant, but not the Navy, or the Marines. Just ask for help...

Pres. Abraham Lincoln

the Treasury, is sensibly subordinate to the Navy in time of war.

My interest in unity of command and in Clausewitz developed out of an article which mentioned Marshall used the phrase in a chief-of-staff report. Aside from that, my only historical knowledge of the phrase was its use some years after the Civil War by James Russell Soley, identified as "Professor, U.S.N." It is a classic description of the inadequacy of cooperation in military affairs, and I quote it at length:

"The total failure of the Confederate fleet on the Mississippi was largely due to bad management and to the want of a proper organization. Authority was divided between the State Government and the Confederate Government, and still further between the army, the navy and the steamboat cap-

tains. The War and Navy Departments at Richmond did not work together....This condition of affairs was all the more remarkable, since the strategic position of New Orleans and the river was of vital importance to the Confederacy, and the post required above all things *unity of command* [emphasis added]....Had one man of force and discretion been in full command and provided with sufficient funds, the defense would at least not have presented a spectacle of complete collapse."[2]

I am writing this article because of criticism about the organization of America's defense in the September 1984 issue of *Afterburner*, USAF newsletter for retired officers. Under the heading, "Speaking of Defense," it noted there is disagreement whether a single uniformed man *with command authority* (logically, he should be the present chairman of the joint chiefs of staff) should be placed above the chiefs of the Army, Navy, and Air Force. Under present U.S. law, the military chain of command in each of the three services is topped by its chief of staff, *with no single military command above them.* The joint chiefs, as a group, perform only an advisory function. Those service chiefs receive their orders directly from the president, a civilian, as commander-in-chief, through the civilian secretary of defense and the civilian secretaries of the three services. In other words, *there is no single military expert in command of the nation's defense,* which unity of command requires if it is a Principle of War. It is interesting that the concept was tacitly acknowledged when, after World War II, the War Department and the Navy Department were abolished and a single Department of Defense established, with its three subdivisions of land, sea, and air.

American law wisely subordinates military leaders to civilian leaders. A theoretical objection to a single top military leader exercising unity of command over all defense forces is his potential for abusing great power, and unsurping the constitutional authority of the president over the military establishment. An answer to that objection is that such a person would have a limited tenure of office, too little for establishing dictatorial power, and that would be powerless without securing connivance of the service chiefs in a *coup d'etat.* The United States of America is not comparable to an unstable Latin America "banana republic" subject to military dictatorships.

I submit that unity of command is an inviolable Principle of War and, as with all principles, deviation therefrom is perilous and not conducive to the proper defense of our republic.

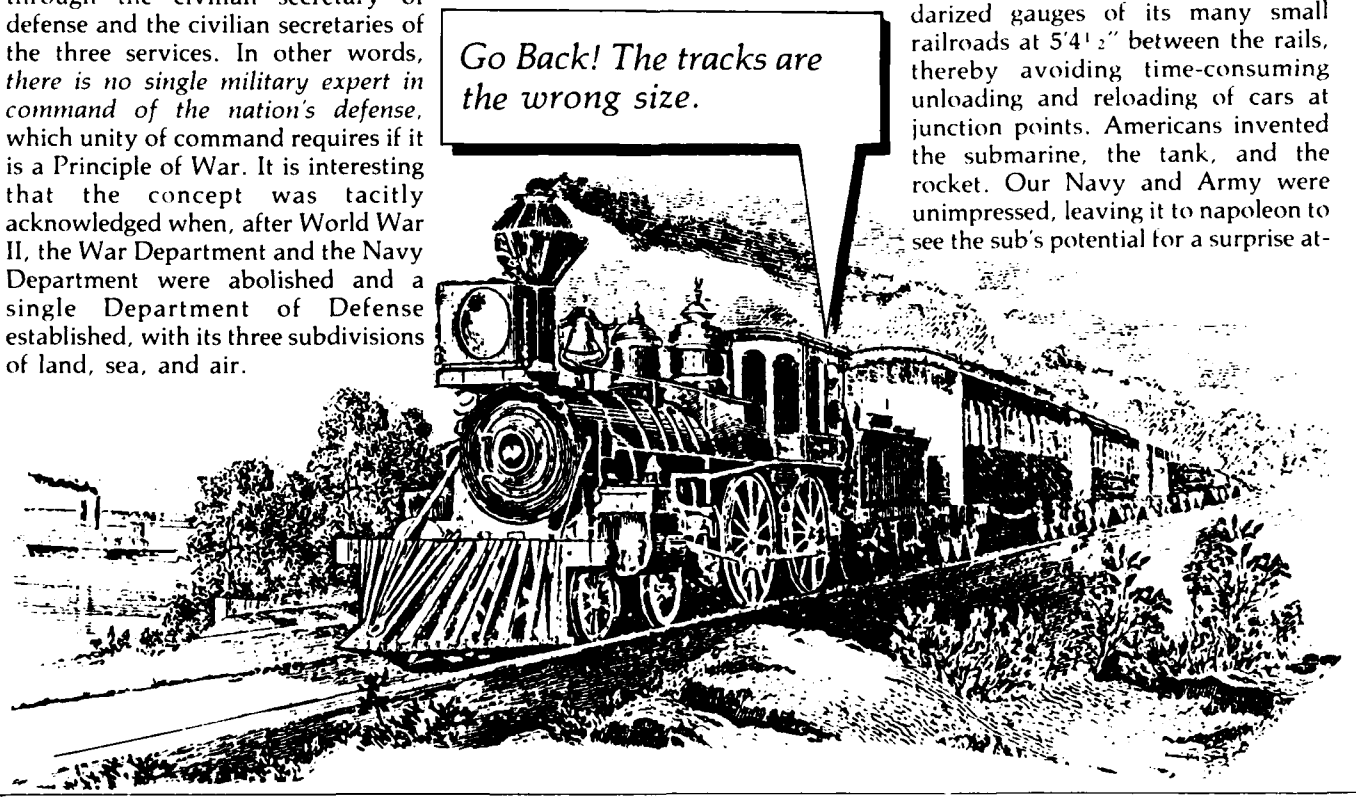
The Principles of War Today

We must consider whether Principles of War are applicable in the present nuclear age. The first consideration is that nuclear power does not eliminate the probability of traditional non-nuclear wars. There have been scores of land battles in the world since World War II, including the invasion of Grenada in 1983. But what of nuclear war itself? The answer must be that the Principles of War are eternal, and that only their application to a specific war varies.

I trust that our Department of Defense has adequate preparations for such an application in our nuclear age.

That cannot be taken for granted. Note the present controversy about the value of the "high frontier" concept (its opponents call it "star wars"). It consists of non-nuclear devices positioned in space and designed to destroy nuclear missiles as soon as they leave the launching pads.

United States military minds have an historically bad reputation for tardy visualization of what the next war will be like. The Southern states, which threatened secession for over 30 years, began the Civil War without realizing troops and equipment would be transported on railroads. It was only after that war that the South standarized gauges of its many small railroads at 5'4½" between the rails, thereby avoiding time-consuming unloading and reloading of cars at junction points. Americans invented the submarine, the tank, and the rocket. Our Navy and Army were unimpressed, leaving it to napoleon to see the sub's potential for a surprise at-



tack across the English Channel; to the British to see the tank's potential for World War I; and to Hitler to perfect the rocket. After the British demonstrated the tank's value, only Patton in the mid-1930s, with inadequate funds, practiced American maneuvers with the tank as an improvement over his beloved cavalry.

Before World War II, Army instructors at service schools traditionally "fought the last war," rather than the next one, in their training exercises. In the mid-1930s, cavalry reserve officers were handed topographical maps of the Gettyburg area for their "on-paper" tactical training, although the world's trouble spots were Japan in the Pacific, and Hitler in Europe. Worse, in 1936, with Hitler feverishly mechanizing his army and developing rockets to span the English Channel, U.S. cavalry officers' training was on horses that could gallop only a few miles before exhaustion; and an officer practiced on horseback the fine art of stabbing a sandbag (infantryman) with a sabre, a weapon with an effective range of 5 feet beyond his shoulder. The first thing the Army did after Pearl Harbor was, belatedly, to abolish the horse cavalry.

Are we ready for the next war, whether it be on land or in space? I am disturbed about the lingering controversy over "high frontier" and the endless controversy about whether our stockpile of nuclear missiles is adequate. Our criterion regarding missiles seems to be the size of our stockpile relative to Russia's. Is there no fundamental and controlling Principle of War we can apply to this matter? Military history demonstrates that relative strength is not a Principle (Lee was always outnumbered). A commander can have more firepower than he needs for accomplishment of the mission. As in the science of logic, it is vital to ask the right military question. Should we ask whether Russia has more firepower in terms of types and quantities of missiles than we have, or should we ask whether we have adequate firepower for accomplishment of the mission, regardless of what Russia has? Perhaps the answer lies in Clausewitz's Principle of War: Economy of Force, which Army supply officers translate into having "enough for now." How many missiles are "enough for now," including the reserve? That depends, obviously, on the Principle of Accomplishment of the Mission. What is the proper mission of our nuclear power? Is it the destruction of an enemy nation, or is it the deterring of a nuclear attack against us? I submit that America has raised deterrence to the level of a Principle of War, at least in the sense that the best form of national defense is the prevention of war. Unfortunately, the adequancy of a deterrent is definitely known, and only in a negative sense, in the moment it has failed to deter.

I am fortunate in not having the awesome responsibility of applying the eternal Principles of War to the nuclear age. I have not mentiond Mobility, a feature of the nuclear submarine and B-1 bomber. The cavalry immortalized mobility in their motto: *Mobilitate Vigemus* ("We wage war by movement"). Hilter mechanized this Principle of War and called it *Blitzkrieg.*

I must mention Air Superiority. The army's Billy Mitchell is generally credited with raising it to the level of a Principle of War, although he was court marshalled for rashly stressing the concept to the degree of "conduct unbecoming an officer and a gentlemen." That was in the 1920s, but we should be hesitant in deeming Mitchell the first to conceive the idea. In the days of Robin Hood, England invaded France and, recognizing the "air power" of the long bow with its range of 600 to 900 feet, smothered the French in a cloud of arrows. There was the navy's John Paul Jones. After his ship was grappled to the opponent's, Jones placed his sailors and Marines high up in his rigging, from which altitude the Air Superiority of their musketry forced the British to retreat below decks. This left the way open for an American volunteer to end tha battle by dropping a grenade down a British hatch.

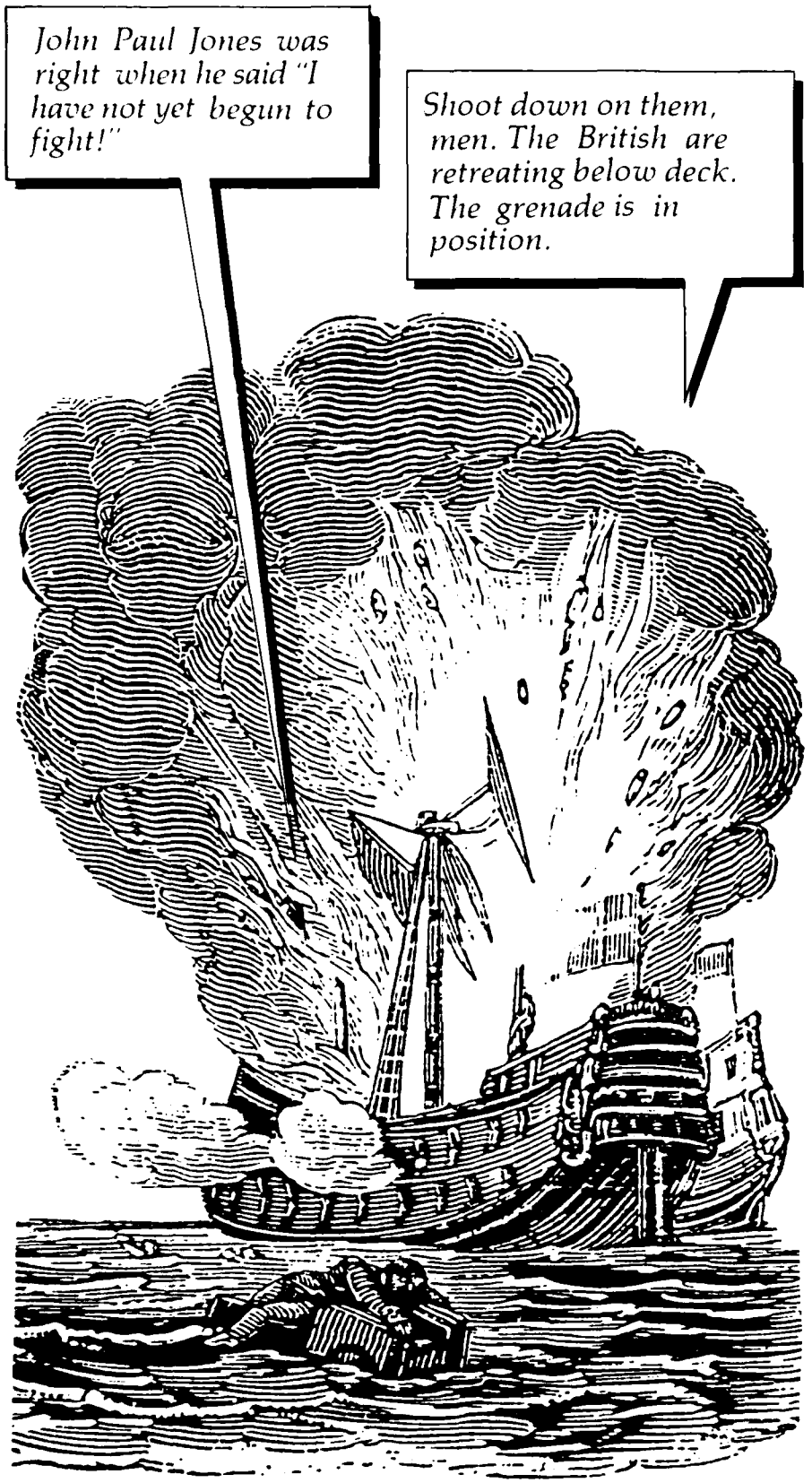
I am tempted to think that the military oath should include inexorable adherence to the eternal Principles of War.

Summation

After completing the above, I encountered an interesting example of Task Force. The *Army Times* (8 13 84), under the heading of "NATO May Face New Soviet Battle Doctrine," described Russian armored divisions supported by heliborne forces. They would sweep into NATO territory with the mission of a quick-win conventional war. This would be accomplished by seizing command posts, airfields and other nuclear weapons sites, thereby severing communications and neutralizing missiles before they could be used, all of this a part of an integrated Warsaw Pact conventional attack.

But how is that a "new" battle doctrine? Its most important feature is in the Principle of Surprise, which was lost by becoming known to NATO. It is no more than an application of the Principle of Mobility as exemplified by Hitler's *blitzkrieg*, Patton's mechanization airborne infantry, and paratroopers. The most interesting feature is Russia's application of the Principle of The Objective, which is *blitzkrieg*-like neutralization of NATO missiles before they can be launched by means of conventional invasion forces. But is Russia too optimistic? Does not NATO use the military planning technique of estimate of the situation, based on determining not an enemy's actual intentions but rather what the enemy *can* do, with emphasis on the worst it can do? Surely NATO recognizes the Principle of War, Accomplishment of the Mission, and knows it cannot accomplish the mission of its missiles unless it has taken precautions to protect missile sites from being overrun by conventional forces. This calls to mind a Principle of War not previously mentioned herein: For Every Offensive Weapon a Defense is Ultimately Designed, beginning 3,000 years ago when the shield opposed the sword.

Mention of the Warsaw Pact emphasizes another Prinicple of War: My Ally Fights Not for My Self Interest But for His Own. During most of Washington's life, England and France were at each other's throats. In his youth, Washington fought the French not to aid England but to obstruct France's expansion in America, only to have France come to his aid in the War for Independence not for America's sake but as a strategic move against England. My ally is trustworthly only to the degree that his self interest coincides with mine. British statesmen recognize in their dictum that "Britain has no permanent friends," fighting with Germany against France's Napoleon and with France against



Germany in two world wars. Our interest in NATO is not for Europe's sake but to keep Russian influence as far from us as possible, an objective first enunciated in 1820 in our Monroe Doctrine, which proclaimed:

"...as a principle in which the rights and interests of the United States are involved, that the American continents, by the free and independent condition which they have assumed and maintain, are henceforth not to be considered as subjects for future colonization by any European powers ....we should consider any attempt on their part to extend their system to any portion of this hemisphere, as dangerous to our peace and safety."[3]

(I am thinking of Cuba, Nicaragua, El Salvador, and Grenada.)

It is interesting to apply the Principle of My Ally Fights Not for My Self Interest But for His Own to the Warsaw Pact, which Iron Curtain nations signed only because a Russian pistol was at their heads. What will those oppressed "allies" of Russia do if Russia marches across them to West Germany? What, especially, will the East Germans do? Can Russia guarantee to itself that these "allies," who require large Russian forces to keep them such, will fight for Russian expansion into West Germany? What, indeed, would their self interest be? Can Russia be assured that it will not be guerrilla-type obstruction of the Red Flag? At best, it is a long march from Moscow to Bonn through hostile territory, perhaps a greater logistical problem in conventional war than a military one, with an ocean of gasoline needed by Russia.

Surprise, for one side or the other, if West Germany is invaded, probably will be decisive. We should remember that, after the Hungarians ejected the Red Flag in 1956, it re-entered Hungary only because Eisenhower abandoned the Principle of Surprise by fortuitously notifying the world that America would not aid Hungary if the Red Flag was carried back into it.

Before World War I, the Balkan nations were deemed the flammable "tinder box" of the world and, sure enough, the spark of that war was ignited at Sarajevo in Yugoslavia. Now, the Middle East is called the "tinder box," but it may still be the Balkans. When Ireland's statesman, Edmund

Burke, stood in the British parliament a year before our Declaration of Independence and chastized parliament for oppressing the American colonies, he spoke admiringly of something the Balkan nations share with Americans: "the spirit of liberty."

Conclusion

A century before our Declaration of Independence, Ireland's John Philpot Curran proclaimed: "Eternal vigilance is the price of liberty!" Inasmuch as Eternal Vigilance is the opposite side of the coin of Surprise, it is a Principle of War. Why must we have a vigilant foreign policy supported by an adequate defense posture? Obviously to protect America's destiny. And what is that? No one, not even Washington and Lincoln, expressed it better than did America's great senator, Daniel Webster, in a June 17, 1825, oration dedicating the Bunker Hill Monument on the 50th anniversary of that battle:

"If in our case, the representative system [republic] ultimately fails, popular governments must be pronounced impossible. No combination of circumstances more favorable to the experiment can ever be expected to occur. The last hopes of mankind, therefore, rest with us...

"The principle of free governments adheres to the American soil. It is imbedded in it, immovable as its mountains....

"Those [the colonial Americans] who established our liberty and our government are daily dropping from among us. The great trust now descends to new hands....We [Webster's generation] can win no laurels in a war for independence. Earlier and worthier hands have gathered them all....But there remains to us a great duty of defense and preservation....

"Let us develop the resources of our land, call forth its powers, build up its institutions, promote all its great interests, and see whether we also, in our day and generation, may not perform something worthy to be remembered... bered....

"And, by the blessing of God, may that country [America] itself become a vast and splendid monument, not of oppression and terror, but of Wisdom, of Peace, and of Liberty, upon which the world may gaze with admiration forever!"[4] ■

FOOTNOTES

1. *Battles and Leaders of the Civil War*, a symposium, (Thomas Yoseloff, Inc., New York, 1956), Volume 3, p. 253.

2. Ibid, Volume 1, p. 628.

3. Edmund Burke, *Speech on Conciliation with America* (American Book Co., New York, 1904), p. 55.

4. J. V. Denney, ed., *Washington, Webster, and Lincoln* (Scott Foresman & Co., New York, 1920), pp. 97-99.

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"The great thing is to get the true picture, whatever it is."

—Winston Churchill

Administering Configuration Management

Arnold N. Hafner

"Programmers tend to continue refining their product even after the original program has been shown to meet its design goals....By implementing the proper configuration control and accepting only changes to the program that fix reported errors, some control is maintained over this problem."
—U.S. Navy Report

Computer systems development requires a rigorous accounting tool with which to monitor the assembly of the system and ultimately to control the proliferation of system embellishments. Properly applied, configuration management (CM) is an appropriate tool and it exists, to some degree, in most development programs. The problem is that without an appropriate definition of the boundaries within which the "management" should take place, a configuration management effort tends to define its own activity limits in terms of the size of the labor force available. This, of course, is a perfect application of the adage that: "Work expands to fill the time allotted to it."

Value-Added Configuration Management

Frequently, development program managers address the "bottomless pit" syndrome by cauterizing the configuration management support function at each branch of its potential growth. They curtail any imaginative working committee or study paper with the financial restraint of labor cutbacks. This is a relatively unimaginative and inefficient cure since it restricts the scope of the configuration management efforts without measuring their contribution. To be sure, it controls CM costs but it also deprives the program manager of a variety of potentially valuable ancillary support services that are "nipped in the bud."

A truly responsive configuration management effort is one that aids the program management process in ways that amplify the basic management function. There is a great deal to be said for the value of a configuration management effort whose personnel are sufficiently experienced and motivated to provide spontaneous program management aids. The configuration management effort is, after all, a focal point for all system change ideas. It is also the repository of the development history of the program. Configuration management is the "corporate memory" of all of the technical innovations and concepts that have been analyzed and attempted or discarded.

It is the repository of the development history of the program.

Managing the Configuration Management Effort

The key to efficiency, and cost-effectiveness in a configuration management effort can be found in the creation of an empirical measurement against which the growth of the configuration management support effort can be evaluated. We are familiar with the most simplistic and inappropriate application of this principle: the niggardly measurement of the flow of paper. All too often we see the effectiveness of configuration management projects evaluated on the basis of the number of change reports that are processed; i.e., system change reports or equipment change reports.

This type of evaluation leads to cursory processing of requests, creative accounting, and even to active solicitation of trivial requests. This approach, being a gross overview, often overlooks system "idle time" during which the configuration management personnel are researching and awaiting information or additional system change reports. This is exactly the time which, in properly motivated and spontaneous configuration management efforts, lends itself to the creation of white papers, amplifying reports, or coordination proposals.

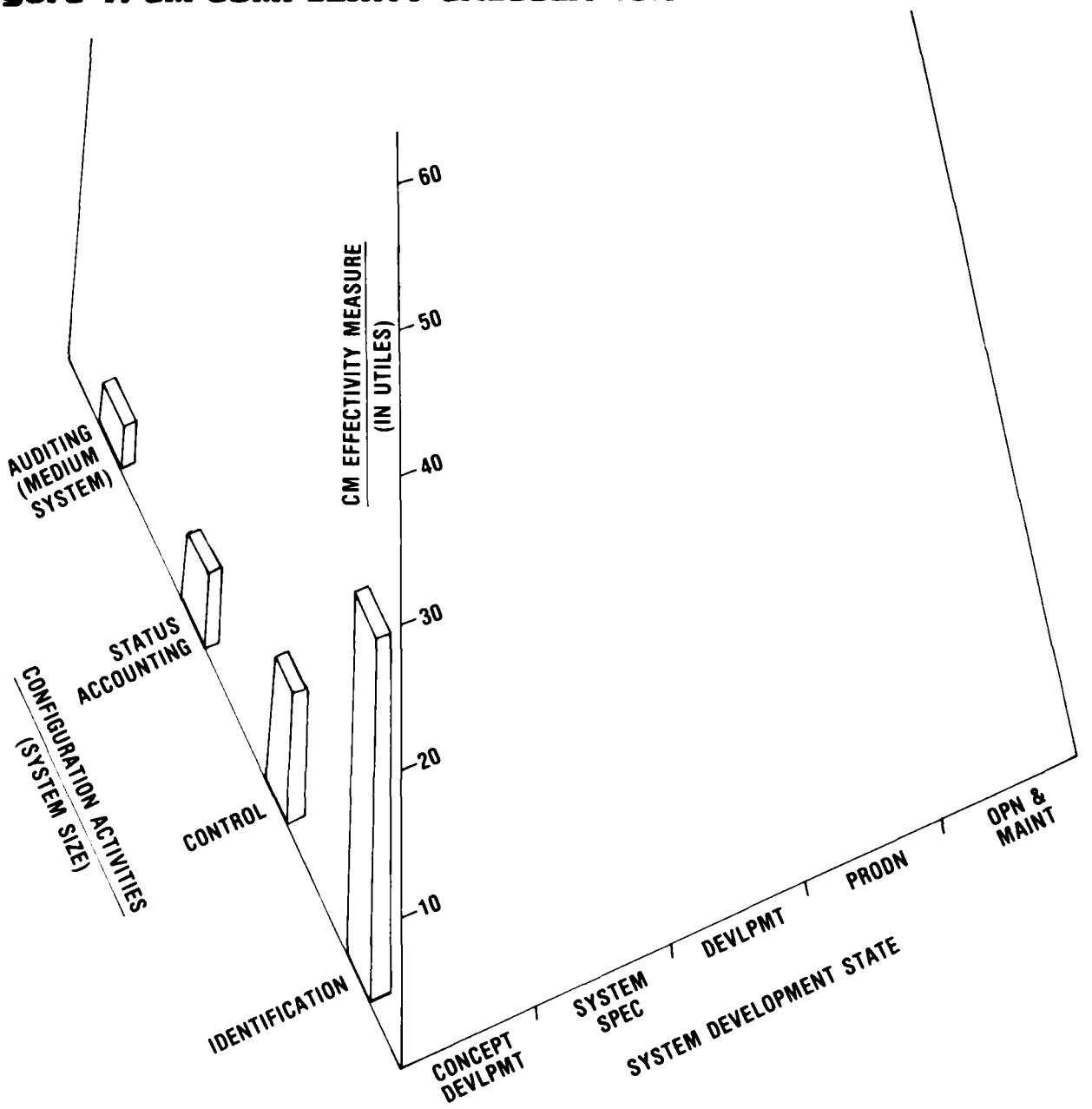
On the other hand, when system change report "idle time" is incorporated into measurement schemes, it is often accommodated by the use of a weighing factor that adjusts the evaluative score according to the priority level (i.e., urgency) of the reports being processed. This scheme is deficient, from the development program manager's viewpoint, because of its dependence upon the value place upon each system change report by an external (client) agency in assigning the priority, and not upon the value of the support rendered to the program manager.

Evaluating the Configuration Management Effort

Is there a balance then, between a "barebones" configuration management and "gravy train" configuration management? If so, it is one in which there is an appropriate level of service provided both to the management of system configuration and to the program management process. Achieving and measuring this balance can be accomplished by evaluating the configuration management effort objectively in view of its contribution to the whole program.

This holistic approach can best be achieved by evaluating configuration management performance functions as

Figure 1. CM COMPLEXITY CALCULATION



they apply within the specific timeframe of the system under consideration. This is to say that there are alternative levels of configuration management and different areas of emphasis that are appropriate during different times in the life cycle of the developing system.

Each computer-based development project has a different level of complexity during each of its stages of development (e.g., conceptual, definition, coding, installation, maintenance) and the configuration management effort appropriate to each of these is necessarily not the same. Likewise, configuration management is compartmentalized into various activities (e.g., identification, control, status accounting, and auditing), each of which have different foci during different development stages. By using an empirical measure that allows for activity fluctuation, the practical manager can resist the temptation to squeeze all of the slack out of his management support effort at a time when the system is approaching a major increase in activity. At the same time, the existence of a parametric measure precludes an unbounded and unfruitful cost amplifying effort by providing a gauge against which to measure relative return on cost.

Categorizing the System

When considering system maturity as a configuration management size delimiter, one can appreciate that in

the early stages of system development participation by key technical personnel can be minimal. For example, in the concept exploration phase the personnel skills required are those of correlating, updating, and filing of documentation. However, during the development phase, the focus of configuration management is transformed into "configuration tracking." During this phase, through its control and status accounting activities, the program management office (and all parties to the development effort) uses CM to keep pace with the evolving devices and their components. However, it is at the production decision benchmark that configuration management truly comes into its own as a uniquely separate, and cost-reducing program management activity.

The production (and distribution) decision is the point in system development support where the accounting and enforcement (auditing) activities of the configuration management process achieve primacy over the technical development and budgetary functions. The configuration management tool is unparalleled in its utility for directing the maintenance and upgrading of fielded systems.

During the installation and operational life of the product (often as long as 20 years), the system can be expected to undergo periodic modification and upgrading. The management of these changes mandates rigorous control if the organization is to have a homogeneous application of its new system. This is the time when a well-founded and structured configuration management effort repays its initiation costs. At this point, the baseline of documentation and historical control, which was so rigorously established during early system development, emerges as established policy and corporate memory.

Developing the Evaluator

How, then, can the program manager optimize his configuration management costs and still ensure the spontaneity and latitude necessary to provide a viable, enhanced support tool? As stated above, each program and, therefore, each configuration management effort, is in many respects unique. Accordingly, one feels instinctively drawn toward the need for an objective, adjustable measure of the configuration management effort. This inclination should lead to a tool that controls without unnecessarily restricting or unjustifiably bloating the configuration management effort. Such a measurement device, if available, would enable the fledgling program manager to judge whether the configuration management service he is receiving is too lavish in its support or too austere in relation to the complexity and maturity of his particular system.

Clearly, there is no ready measurement tool in existence that measures even these gross limiting evaluations—much less a rating of the gradations between them. Perhaps, for the short term, the instinct of the program manager is the best evaluation of this sort of effectiveness. Nevertheless, in major programs, the program manager is often too far removed from the configuration management effort to be an effective arbiter of its size. The PM needs to develop his own evaluation instruments to allow him to monitor the effort through program review and briefing techniques.

The Creation of a Measurement Device

A catalog of appropriate configuration management tasks is presented in Table 1. These activities represent the basic elements of configuration management and can be used to formulate a baseline evaluation instrument against which to measure CM activity. In creating a preliminary model of configuration management effectivity, one should account for both the complexity and maturity of the system. The generic configuration management activities (identification, control, accounting, and auditing) vary in difficulty according to the complexity of the development program and the state of development of the system.

Figure 1, the CM complexity calculation, presents this concept as a three dimensional histogram. The figure illustrates the estimated cost of a distribution of configuration management activities across a hypothetical, medium-sized, unstable (i.e., changing), and immature system development program.

System size is, perhaps, an instinctively obvious measure of system complexity. However, system stability and maturity (and their effects on system development) are subjective concepts that are treated throughout the DOD development literature, and which are certainly best understood from a base of experience in systems development. Accordingly, using a utility scale (Figure 1) presents an intuitive portrayal of the relative costs of each generic CM activity at a particular time in the system development process.

Although the scale of this illustrative analog is calibrated linearly in utiles, program-specific research must be conducted to establish and justify a literal interpretation of a working model. Accordingly, each program manager must calibrate his own configuration management expenditures in the light of ongoing activities and vis-a-vis the sophistication and development state of his system. This can be done as follows.

The model illustrated in Figure 1 shows that the identification activity for a conceptual system can be expected to be more complex and, therefore, more resource intensive than, for example, the auditing activity. The effectivity measure takes advantage of these relative activity differences, and of the knowledge that they will vary in relation to each other throughout the life cycle of the program. It simply assigns a value to the *status-quo* activity costs and then measures the relative difference in future activity levels to ascertain the evolving distribution of CM expenditures. Knowledge of this evolving distribution can be related to the expected distribution or to activity levels of similar, parallel programs.

Table 2 presents a format and refines the concept of a CM activity effectivity measure by cataloging the effort in terms of project size, developmental stage, and the aggregate relative costs of the CM activities. In this example, a baseline study has been conducted in which a consensus of program participants have assigned utile values to each of the ongoing CM activities.

■ *Dr. Hafner is department manager for the Surveillance-Intelligence Department, and is also the contract manager and principal investigator for the Integrated Systems Program, Computer Sciences Corporation, San Diego, Calif.*

The baseline evaluation is postulated on a budget of 100 "utiles" and the illustration shows that after a thorough program review we can account for only 70 utiles in CM related costs. The need to account for the contribution of the remaining 30 utiles is exactly the role that the effectivity measure is intended to fill.

The subjects of utility theory and of conducting utility surveys and consensual validation are left for the reader to pursue in other material. However, regardless of the initial assignment of utile weights, if the assessment is made early enough in the program one can create a baseline against which the future costs of the program CM efforts can be measured. In this way, the program manager can observe the change in CM resource allocation as his development program progresses through the stages of system maturation. At the least, he should expect to observe a shift in the focus of the efforts of project personnel as the different activities of configuration management reach their primacy.

Once formulated, the empirical configuration management measure can be calibrated to reflect the effectiveness of the growth of configuration management as the development effort matures. It also can be used as a relative measure of module (subproject) efficiency if enough confidence can be placed in its consistency as an evaluative tool. This latter is actually a proposal to use the configuration management evaluator as an instrument to evaluate the development effort through its maintenance costs. It assumes that the CM measurement tool has been validated either by long-term program application or through application to numerous, independent configuration management efforts.

Regardless of how the effectivity of a configuration management effort is measured, it is clear that there is a happy medium between austere and inflated configuration management projects. The *sine qua non* of effective system development management are continuity and tenure. Whenever program management is committed to this concept, it is well worth the effort required to develop and apply an empirical configuration management measurement procedure. The cost control provided by such a device can be extremely valuable but the motivation and synergy that such an optimization process can be of even greater benefit to the entire system development process. ■

Table 1. CONFIGURATION MANAGEMENT ACTIVITIES

I. IDENTIFICATION
- A. Specification of Configuration Item (CI)
- B. Evaluation and Classification of CI Specifications and CI Relationships.
- C. Preparation and Processing of Drawings
- D. Definition of Base Lines
  1. Functional Base Line
  2. Allocated Base Line
  3. Product Base Line
- E. Definition of Cataloging Structure

II. CONTROL
- A. Establishment of Change Criteria
- B. Definition of Change Classifications
- C. Evaluation of Deviations and Waivers
- D. Processing of ECPs
- E. Implementatioon of CCBs
- F. Performance of Change Evaluation
- G. Determination of Change Approval
- H. Monitoring of Change Implementation

III. STATUS ACCOUNTING
- A. Assignment of Responsibility for Changes
- B. Maintenance of Records and Reports
- C. Supervision of Data Content of CM Database

IV. AUDITING
- A. Performance of Verification and Validation of CI's and Changes
- B. Performance of Functional Configuration Audits
- C. Performance of Physical Configuration Audits
- D. Preparation of Audit Reports
- E. Preparation of Audit Plans and Schedules
- F. Conduction of Design Reviews and Design Audits

Table 2. CM EFFECTIVITY MEASURE

Complexity:	Size	—medium [◄50,000 lines of code]
	Stability	—high instability [replacement for newly implemented, and evolving, business process]
	Maturity	—low [system being modeled is itself new and unstructured]
	Staff Size	—small [◄12]
Developmental Stage:	Advanced Development	

Relative Activity Costs:	
Identification Tasks	30
Control Tasks	20
Accounting Tasks	15
Auditing Tasks	5
Composite Efficiency	70

It's in the Mail!

The Program Manager's Notebook

Your contributions to our PM's Notebook have helped us meet our objective. The Notebook, with more than 60 Fact Sheets, is printed and in the mail.

In previous issues of the *Program Manager*, we said the Notebook will provide program managers with a ready reference document that will contain basic information and a reference list on selected subject areas of interest or concern to them. The Fact Sheets, approximately six pages in length, are designed to provide:

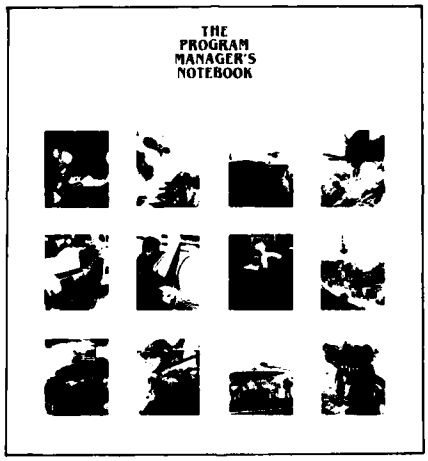
—Ready reference to brush up on a topic without searching through lengthy reports, studies or articles;
—Essential summarized guidance for performance of functions or preparation of documents in the selected subject areas;
—Succinct summations of the Department of Defense and, if appropriate, service philosophy and policy regarding acquisition subject areas.

This guidance should assist program managers as they perform the functions and prepare the documents associated with the systems acquisition cycle.

The loose-leaf notebook format will facilitate your adding to the initial increment of 61 fact sheets and should simplify the continuing revision and updating process.

In the March-April issue of the *Program Manager*, we asked you to share your knowledge with the rest of the acquisition community and write a fact sheet for the Notebook. Concurrently, we asked resident students of the Program Management Course here at DSMC to do the same. We selected those fact sheets that met our criteria and included them (with some editing where appropriate) in our first increment. You contributed 10 of the total 61 fact sheets that constitute this first increment. The quality and content were generally excellent and certainly supported DSMC's recognition of the fact that the knowledge and expertise that resides within the acquisition world must be continuously shared among all of us.

The names of non-DSMC authors whose fact sheets are published in our Notebook are listed in our Contributing Authors Honor Roll. Each author will receive a personal copy of the Notebook to recognize his participation in this effort. Our thanks to each of you for your help.



Ten of sixty-one Fact Sheets were produced by other than DSMC authors.

Please continue to support this effort by telling us how we can improve the Notebook and make it do more for you. Use the tear sheet in the back of the Notebook for your comments, or write or call Edward Hirsch, Professor Systems Acquisition Management, Defense Systems Management College, Fort Belvoir, VA 22060-5426. Telephone: (703) 664-4795 5783; AV 354-4795 5783.■

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SYMPOSIA

Acquisition Research Symposium Abstracts

A brief look at some of the papers presented at the 1985 Federal Acquisition Research Symposium.

The Defense Systems Management College hosted the 1985 Acquisition Research Symposium for the Department of Defense and the General Services Administration at Richmond, Va., November 20-22. The theme was "Today's Research—Tomorrow's Rewards."

Abstracts of about 40 of the papers presented at the symposium are reproduced below, categorized by subject area. If you are interested in obtaining a copy of the proceedings of the symposium, which includes more than 80 papers contact the Defense Technical Information Center (DTIC), Cameron Station, Alexandria, Va. 22314, Phone: (703) 274-7633 or Autovon 284-7633, or the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, Va. 22161, Phone: (703) 487-4650.

When ordering from either place, refer to ADA 160 666.

ACQUISITION POLICY

"The Possibility of a Contracting Science" by Robert F. Williams and Paul F. Arvis

The conduct of contracting research has many constraints in terms of customer short-term orientation, data difficulties, the political nature of government business and other factors. Consequently, rather than rigorous and objective studies, contracting research often results in anecdotal reports and essays, with little empirical support and limited credibility in the conclusions. The establishment of a contracting science would allow for a systematized approach to gaining knowledge and insights in contracting. The paper maintains that the four criteria for establishing a contracting science can be met: a distinct subject matter, the contract; a description and classification of the subject matter; underlying uniformity among contracting phenomena; and the use of the scientific method in studying contracting. However, many actions must be taken to meet these criteria, such as rigorous development and then promulgation of the criteria as a science; the planning for maintenance of the science, to include a body of knowledge, the solicitation of candidate contracting theories, and the encouragement of the use of the scientific method; the development of ethical standards, and the development of mechanisms (schools, associations, practitioners, researchers, etc.) to institute the concept. The paper points out that prudence must be exercised in moving out on the concept.

"A Cybernetic Model of the Defense Weapon Systems Acquisition Process" by Dr. Fred Waelchli

An original cybernetic model of the weapon systems acquisition management (SAM) process—based on Beer's self-vetoing homeostat—is introduced. The model requires a multiparty "win/win" strategy for success in SAM. Concrete examples of "win" requirements for various SAM participants are examined. The climate for win/win in SAM is shown to be bad, and worsening. Theoretical and national defense implications are explored.

"A Revolutionary Approach to Shortening the Defense System Acquisition Cycle" by Col. G.W. Acree II, USAF; Col. R.C. Lewis, USAF and Dr. Abraham Singer

Every year added to the acquisition cycle results in a substantial increase in the ultimate unit cost (ten percent or more, according to many experts) of the weapon system. This paper proposes an approach that would shorten the acquisition cycle of major systems by as much as 5 years—giving the taxpayer a significantly greater return on his defense dollar. In addition, the approach would simplify the process considerably and restore our technological leverage in the field.

This approach is termed revolutionary in acknowledgement of the enormous opposition it is sure to encounter in the bureaucracy. The approach hinges on delegating the oversight of the concept exploration and demonstration/validation phases to the services, allowing them to carry *candidate* systems during these phases in a modified technology base or however else they deem appropriate. The requirement for a new major system would then be established and "blessed" by OSD in conjunction with the initiation of full-scale development.

The paper compares the advantages and disadvantages of the new approach with those of the existing DOD major system acquisition process.

"Disciplined Engineering—An Elusive Process" by Paul J. McIlvaine

The orientation of the engineering art can be shown to parallel the value society places on continuing success in the long-run versus quick, short-term, success. Young engineers in the United States are often inadvertently taught to design something that works, with no further requirement to balance cost, supportability, schedule or manufacturability. This tendency adversely affects the production and logistics support phases of the systems life cycle, since the designer's decisions have a most critical impact on producibility and downstream operation and support. DOD policy supports the notion of a long-term orientation, which is just starting to permeate practice.

The acquisition cycle for new major defense systems currently takes, on the average, 14 years from initial idea to material fielding. Original design specifications for many of these systems call out a service life of only 10-15 years. Historically, many defense systems such as the B-52, USS New Jersey, and M-60 have been operated longer than their expected service lives—30,40, and even 50 years. This is accomplished by means of product improvements, modifications, and service life extension programs. [1] Modifications also allow new advances in the state-of-the-art to be incorporated into these existing systems much sooner than by starting the acquisition cycle over again.

ACQUISITION STRATEGY

"Acquisition of Command and Control Systems Is a Different Ball Game" by Brigadier General Kirby Lamar, USA (Ret)

Command and control systems, especially decision support elements, are very different from most weapon systems and should be acquired differently. That principle was a key conclusion of the 1978 Defense Science Board (DSB) study of command and control system management. In 1982 the Armed Forces Communications and Electronics Association (AFCEA) completed a study of Command and Control System Acquisition, which further established the need for an evolutionary acquisition approach for most decision support systems. The AFCEA study also described evolutionary acquisition approaches and included specific recommendations for applying evolutionary acquisition. A recent survey of many senior command and control system managers corroborates the recommendations of the earlier studies and adds to the understanding of evolutionary acquisition. The traditional acquisition approach is not likely to succeed in acquiring command and control decision support systems. An evolutionary strategy is necessary even though obstacles are caused within the planning, programming and acquisition communities by deviations from the traditional sequential acquisition process. Also, evolutionary acquisition is a relatively new concept with some sticky issues still unresolved. Command and control is one of the highest priority functions of the Department of Defense, and its importance will continue to increase as the pace of warfare quickens and weapons become more accurate and powerful. Evolutionary acquisition should be adopted now as the normal method for acquiring command and control decision support systems and high priority given to making that method as efficient as possible.

"Significant Impacts on Acquisition Strategy Execution" by LtCol Leslie R. Swanson, USAF, (Ret.) and F.B. Wynn

The July 1984 *Acquisition Strategy Guide* published by the Defense Systems Management College suggests five criteria with which to evaluate an acquisition strategy's capability to provide a basis for gaining program support and meeting established objectives:

—Realism

—Stability

—Flexibility

—Resource balance

—Controlled risk

In meeting the requirements of the 1976 Office of Mangement and Budget Circular A-109 that a tailored acquisition strategy be used for each major system development and procurement, DOD and the individual services have gradually clarified implementing guidance for the structure and content of acquisition strategy documentation. So much recent attention has been given to the *development* of the acquisition strategy that its preparation is now becoming an accepted step for gaining program support during the initiation and planning phases. What about *execution*, however? Has the acquisition strategy been successful in helping the program manager meet the established objectives?

This paper provides insights into specific difficulties encountered by program managers in the execution of their acquisition strategies. Information sources included questionnaire responses from program management office personnel, selected follow-up interviews, supplemental discussions with OSD and service headquarters staff elements, and applicable published material. The most frequent and troubling issues faced during strategy execution are highlighted, as are their relationships to the five evaluation criteria listed earlier.

Limitations of the acquisition strategy in helping to meet established program objectives are addressed. There are, for instance, real limits to the preventive planning that reasonably can be done to accommodate every funding eventuality. The paper also suggests where a continually updated acquisition strategy can strengthen the program's ability to stay on course. One area that produces such strength, when reinforced by vigorous, pro-active networking, informal briefing, and personal interaction, is the program manager's ability to evoke a continuing commitment and sense of advocacy.

"Acquisition Strategy" by CDR David V. Lamm, USN

The development of an acquisition strategy by program/project managers which presents the overall plan for successfully acquiring and fielding a major weapon system is becoming more important and complex each year. In recent years, the policy regarding the development and use of an acquisition strategy has become more specific and more demanding. This development, however, has not resulted in a clear definition of acquisition strategy nor has it resulted in a uniform application of broad policy guidelines. The primary focus of this study was development of the acquisition strategy at program initiation. It was found that all acquisition strategies must contain certain characteristics in order to have any chance for success. These characteristics/factors are that the acquisition strategy must be (1) responsive, (2) realistic, (3) comprehensive, (4) integrated and internally consistent, (5) flexible, and (6) serve as a formal agreement. Primary constraints and limitations imposed on acquisition strategies included: (1) formal program planning (2) informal program guidance, (3) economic pressures, (4) political pressures, (5) technical considerations, (6) schedule requirements, (7) resource requirements, and (8) risk factors. The process of developing an acquisition strategy involves (1) determining guidance, (2) identifying what is to be accomplished, why and when it must

be completed and by whom, (3) identifying and evaluating strategic alternatives, (4) selecting an appropriate strategy, and (5) developing contingent strategies. The paper concludes with some findings concerning acquisition strategies in the major weapon systems environment.

ACQUISITION EDUCATION

"Training in Today's Changing Environment" by Conrad W. Kipp, William B. Bentley, and John E. Kernan

This paper presents a method for supplementing a traditional OJT program. Air Force Systems Command's Aeronautical Systems Division has developed and implemented a three-week contracting procedures course (CPC) to teach new buyers the "how to" real world of contracting. A lecture/laboratory approach to learning has been designed, using an operational contract file. This permits exposure of a student to a 1-2 year contracting cycle during the first 2 weeks of the course. In the third week, the students learn contract administration functions. Additionally, the initial step toward an automated training aid is discussed. This aid can also be used to assist experienced buyers. Air Force Systems Command's development of the "computerized buyer job-aide" will provide for a beneficial marriage of tradition and automation. Ultimately, it will give ASD buyers a better, more efficient way to accomplish the Air Force acquisition mission.

"Simulation in Program Management Education" by Forrest C. Gale

Computer-driven scripted scenarios are software sequenced and stimulated processes in which students act and interact individually and in small work groups with each other, with faculty, and with technology resources to achieve learning goals and objectives. A recent DSMC research program has focused on the application of such advanced, state-of-the-art tools to simulate a real-world defense acquisition program office environment. This paper reports on recent work in planning these high-technology interventions, in designing and developing the resultant products, and prototyping and testing the target simulations in a newly developed "automated" laboratory classroom facility which is unique in the field of education. Design artifacts of the simulated defense acquisition management environment are described in considerable detail, as is the psychometric architecture of the prototype scenarios and its meaning and potential for impact on the methods and processes currently invoked in real-world service program offices.

ACQUISITION WORKFORCE

"Contracting Officer Qualifications" by Capt Wendy L. Motlong, USAF, and John E. Verardo, Jr.

Presidential Executive Order 12352 directed government agencies to develop contracting career programs that would produce a professional work force. Under this order an interagency group, Task Group Six, proposed minimum selection and appointment criteria for contracting officers. An Air Force Institute of Technology thesis team examined the task group's criteria as they related to administrative contracting officers (ACOs) in Department of Defense plant representative offices. They conducted a survey to determine the demographic profile of the current ACO work force. Minimum experience, education and training requirements were then proposed based on the task group's recommendations, the ACO demographic profile and the work force's opinions.

"Retaining the Procurement Careerist in the 1980s" by George T. Nickolas

Competent and experienced procurement careerists are being enticed by offers from industry to leave the government. This is especially true for those who negotiate contracts with the defense industry. The offers made by industry promise substantial instant pay increases and commensurate fringe benefit packages. Many times these attractive offers are too tempting for young, highly qualified, motivated and bright people to resist.

This paper will cover the results of a survey taken of more than 500 procurement careertists, GS-5 through GM-15 at Government locations in Washington, D.C.; Detroit, Michigan; and Rock Island, Illinois; who had 1-30 years of government service. The survey was accomplished through a questionnaire which was distributed to these careerists requesting information on what motivated them to seek employment with the federal government and what has kept them with the federal government. The questionnaire explored various elements to determine what factors influenced the retention of these experienced procurement careerists. The paper will review the results of questions which were asked to determine the effect that changes such as grade-level revision, pay freezes, retirement program, and fringe packages (such as sick and annual leave) have on the government's ability to continue to retain these employees. A detailed analysis of the questionnaire will be provided along with the author's conclusions and recommendations. Particular comparison will be made of several private sector retirement programs and the government retirement system. The analysis will include a hypothetical look at how changes in government policy would affect our ability to recruit and retain the intelligent, dynamic people needed to negotiate contracts for the government.

AUTOMATED PROCUREMENT

"CECOM Program Management System (PMS)" by Maj. Kenneth W. Hughes, USA, and Raoul C. Cordeaux

During the period from 1975 to the present, the U.S. Army Communications-Electronics Command (CECOM) developed and implemented a Program Management System (PMS) to assist project managers (PM) in controlling cost growth and schedule slippage. This system was designed to take advantage of the latest in automation and management techniques. The foundation of the PMS is an automated schedule management system incorporating PERT-like dependency networks. These networks enable the PM to plan, schedule and control program execution, and coordinate support requirements. As the system evolved it became desirable and feasible to relate Baseline Life Cycle Cost Estimates (BCE) and actual contract costs (C/SCSC) to program schedule. The ability to tie cost elements to the program schedule is

achieved through a disciplined use of the project summary work breakdown structure (WBS). The one-to-one correspondence between activities in the dependency network and program dollars facilitates schedule/cost tracking, forecasting and analysis. State-of-the-art software programs and hardware equipment provides the means for automating this process. The result is a dynamic program management system with sufficient flexibility to permit individual management styles and adapt to project peculiarities. The benefit is the ability to pro-actively manage the weapon system research, development and acquisition process.

COMPETITION

"Statistical Models for Predicting Overhead Costs" by Dan C. Boger

Statistical models of several years' quarterly overhead costs for selected defense contractors are obtained. Overhead costs are categorized according to types of costs incurred. Using linear regression analysis, total overhead costs are then modeled as contractor-specific functions of the number of direct personnel. In general, excellent structural results are obtained for most contractors after the correct specification of the structure of the least squares error process. Alternative contractors result in alternative error structures which exhibit annual auto-correlation, quarterly auto-correlation, or possibly a mixture of these two. Predictive models, based upon the structural models, are then derived with similar error structures incorporated into the models. In some cases, excellent predictive models are obtained. These results indicate that overhead, at least for this sample, tends to follow variations in output levels through the number of direct personnel.

"AFSC-RATE" by Louis Kratz and Michal Bohn

The Air Force Systems Command's (AFSC) affordable acquisition approach (A^3) study emphasized the importance of stable production planning and execution of Air Force weapon systems programs. In spite of recent attempts to stabilize production programs, adjustments to production profiles continue to occur. Often, these adjustments are necessary to respond to a changing threat or to a restructuring of budget priorities. To enhance production stability on future and ongoing programs and to assist in restructuring programs when necessary, The Analytic Sciences Corporation (TASC) had developed the AFSC Rate Analysis Tool and Estimator (AFSC-RATE).

"Challenge of Claims of Proprietary Rights and Use of Special Contract Clauses to Transfer Technology" by Frank Lukasik, and Theodore Prahinski

The authors set out practical pointers on how to deal with data rights challenges and options to transfer technology in order to establish competition in government contracts. These are based on 55 years of collective experience in engineering and law, including development engineer experience, and 32 years Air Force experience as developers of data rights challenge and option procedures, and as members of the ASPR/DAR Rights in Technical Data and Patent Subcommittees. Government employees ruling on challenges and designing the specific option clauses used must understand the technology involved, and the implications of the specific versions of the contract clauses involved. Challenges must be resolved in time to use the data for competition, but early challenges risk unjustified concession of proprietary rights. Contractor agreement to accept option clauses should be made when competition exists. At this time contractors do not know what components, or subcontractors they will use. Most data problems arise at the subcontract level. The volume of data involved is staggering; the engineering drawings for a military aircraft may total more than 200,000. Buying rights to use data for government contract competition only is much less expensive than buying rights which would harm a contractor's commercial position. The "developed at private expense" standard for private rights really means "brought to the point of practical operation." The government personnel ruling on this question should have enough technical understanding to determine this issue. Using competition to force agreement to furnish technical data and rights may lead contractors to use inferior technology. Technical data need to be reviewed both for proprietary rights, technical completeness, and accuracy. Government needs the right to acquire rights in whatever is "used," but in the exercise of this right needs to stop at some practical level. The recommended level is where components, or products, are available from competitive sources. The government should concentrate on insuring that contractors have good procedures.

CONTRACTING
(Methods and Strategy)

"The Appropriate Use of Incentive Contracts" by John J. Kennedy

In 1961, Secretary of Defense Robert McNamara told President Kennedy that he would reduce the cost of weapon systems by 10 percent merely by changing from CPFF contracts to incentive contracts. The use of the CPFF contract then dropped precipitously over night. The incentive contract and the firm fixed price contract replaced the CPFF. Were costs now under control? Have the incentive contracts and related management systems been effective in curbing cost overruns? What about the implications for cost growth? What changes need to be made? And, what about the conceptual foundations of the incentive approach? Are they still valid? Or, in fact, have they ever been valid? These questions are addressed throughout this article.

In this article, I synopsize my 28 years experience of work with incentive contracts as a teacher, researcher, and consultant. Eight of the fourteen hypothesis from my three-volume set recently published on incentive contracting are analyzed. Specific observations and implications are offered. In conclusion, I pinpoint 16 invalid assumptions that we all have made over the last 20 years, and I provide ten general recommendations for improving incentive contract practice.

"Cost Savings from Multiyear Contracting" by Joseph S. Domin and Robert K. Wood

Two multiyear contracts are reviewed to determine the savings that are being realized over the cost of annual contracting for the same work; one is an Army contract with the Sikorsky Aircraft Division of United Technologies Corporation for the

UH-60A BLACK HAWK helicopter and the other an Air Force contract with the General Dynamics Corporation for the F-16 multimission fighter aircraft. We found cost savings of 8 to 9 percent in our examination of two multiyear contracts. Estimated savings are $81 million for an Army contract for the UH-60A BLACK HAWK helicopter; and $258 million for an Air Force contract for the F-16 multimission fighter aircraft. Our estimate of savings is based on comparing the proposed costs of one multiyear contract with those of several annual contracts over the same time period. The principal sources of savings in order of importance are (1) reduced prices paid by the prime contractor for parts and material, (2) avoidance of price escalation, and (3) improved efficiency of the prime contractor's operations. The criteria for multiyear contracting were found to be appropriate but vague. After several years of cost experience are accumulated, multiyear contract costs should be compared with those for prior annual contracts for the same systems, in order to validate savings and to determine the extent to which engineering and requirements changes reduce them. At that time, the criterion for stability of requirements and configuration should be tightened. The broadening of multiyear contracting to include requirements of all services for the same end-items and for spares, support equipment, and foreign military sales offers an opportunity to achieve even greater savings than are now being realized.

COMPUTER AIDED TECHNOLOGY

"Computer Aided Technical Management Research and Demonstration" by Wilbur V. Arnold

The Defense Systems Management College (DSMC) has been conducting research on the state-of-the-art in computer aided technical management (CATM). Initial results identified many computer aids in the various functional elements of technical management (systems, test and evaluation, production, logisitcs, and cost) but no focus like CAD/CAM for real-time integration of the decision-making process. Therefore, a schematic to serve as a focus for CATM was developed as part of the research effort. This information has been disseminated through a variety of ways: classrooms, seminars, symposia, publications. Reception of the concept has been supportive and, therefore, in-house research to demonstrate the principle has continued. This paper provides background detail of past research and its results along with a description of an architecture to demonstrate CATM. A near-term benefit of the research has been development of a design-choice exercise, which is to be piloted in a DSMC course and results, and which will be available for the 1985 Federal Acquisition Research Symposium.

"Designing for Supportability Engineering in 1990" by John S. W. Fargher, Jr.

The integration of computer-aided design (CAD) and computer-aided manufacturing (CAM) has had a dramatic affect on design engineering in the last 5 years, especially in the aeronautical, aerospace and microcircuit business. In the next 5 years design engineering will undergo another evolution where computer aided-logistics (CAL), computer-aided human factors (CAHF), and computer-aided engineering economy (CAEE) will allow the design engineer and support engineers to evaluate various alternatives as the design is developed. Advanced computer aided design (ACAD) techniques allow the engineer to visualize and evaluate designs in three dimensions, assisting in detailed maintainability engineering analysis to include evaluation of man-machine interfaces and logistics support analysis; estimate reliability, producibility and life-cycle costs based upon design complexity; and optimize design alternatives all before breadboards-brassboards are built. Coupled with the above is a tremendous growth in engineering productivity from 4:1 to 20:1 for ACAD over previous manual methods. The ACAD allows the design team to analyze more completely several different configurations in the time it previously took for analysis of only one design alternative.

The paper describes the use of ACAD throughout the life cycle, from the front-end analysis during concept formulation, through sustaining engineering for pre-planned product improvements. Current research efforts underway in computer-aided logistics, computer-aided human factors, are described. Included are examples such as the JVX human factors engineering (HFE) mock-up designed by the Naval Air Rework Facility, Cherry Point, N.C., in support of the JVX PMO; developing depot support for the AV-8B at the Naval Air Rework Facility, Cherry Point, with a CAD/CAM data base; and a redesign effort for a more supportable engineer generator for the ground launched cruise missile to ensure operational availability in the field. Other examples such as use of ACAD for training manuals and logistics support analysis review are presented.

"CAD-E in the Supercomputer Age" by R. J. Eichelberger

Computer science and hardware have advanced rapidly in the past 40 years, since the construction of ENIAC. The next decade, however, will probably see a more rapid expansion of capacity than the entire previous lifetime of the electronic computer. This prospect raises, at last, the possiblity of performing comprehensive systems engineering on the computer, as opposed to the component-oriented, simplified form of computer-aided design and engineering (CAD-E) that is the accepted method today. The benefits of applying the computer techniques to complete systems would be hard to exaggerate: the savings in time and cost for development, the possiblities of treating producibility and cost-reduction techniques before producing even prototypes, the capability of simulating performance and optimizing the design, all before committing to facilitization, tooling, and small-quantity production will be well worth the preparation that will be needed to fully exploit the future possibilities of the successor to CAD-E.

COST ESTIMATING

"A Methodology for Predicting the Cost Savings Achievable through Multiyear Procurements" by Ernest T. Kendall

This paper describes a methodology for predicting the probable actual cost savings achievable through the use of multiyear procurements in place of a

series of annual contracts. The 2-year acquisition time for multiyear procurements (MYPs) requires Department of Defense (DOD) submission of budgetary estimates of cost savings 2 years prior to receipt of firm contractor bids. Congressional authorization for MYP acquisition of major systems is based in large part on this initial valuation of cost savings. At times in the past, however, the final value of cost savings achieved turns out to be less than the initially estimated value. These incidents have made it necessary to ensure the credibility of future MYP submissions.

The methodology described here is intended to (1) reduce the variance between estimated and actual cost savings due to MYPs; and (2) to establish a standard approach to MYP acquisitions for use by Air Force program offices. Based on the general evaluation and review technique (GERT), the methodology formalizes this approach in the form of a stochastic, nondeterministic network which incorporates feedback loops to permit contingency planning.

"Using Labor Standards for Estimating" by W.M. Chamberlain

Media coverage during the past year has caused the Congress and the taxpayer to lose a great deal of confidence in the ability of the DOD/aerospace industry to control weapon systems' costs. The DOD acquisition process often results in a sole-source environment which does not encourage stringent cost controls. For this reason, critics often plead for expanded competition as the only means of controlling costs. However, very effective cost-control techniques are being used to determine a fair value for our defense products in the absence of price competition. One such technique is referred to as "Should Cost." When the Should Cost" approach is used for estimating, past actual costs are challenged for necessity and efficiency before being used as a base to estimate future costs. The primary objective for implementing the Should Cost approach is to estimate future costs anticipating the greatest manufacturing efficiency attainable. This has proved to be an effective substitute for competition on sole-source procurements. A problem with this approach is that the additional required manpower isn't always available. However, specific industrial engineering techniques can be applied to achieve these valuable Should Cost results. One way is to take full advantage of established work measurement programs, including a well-monitored variance analysis program. Effective use of good labor standards for estimating, along with an appropriate realization factor, will provide this Should Cost diminsion.

"Taking the Art Out of Tool Estimating: Business Research Report" by James L. Storrs

The author began this work toward providing a government-industry tool estimating manual in 1978. The results of his research show that the concept is feasible both manually and via computer mechanization. The author and those who have utilized the approach manually have realized cost avoidances in excess of $50 million. However, the author's research shows that if the approach were computerized, further study by an outside consultant would be required but the resulting return-on-investment would approach 26 to 1. Basically, the concept involves accurately determining tool complexity points between 0 and a maximum of 100 points. These points are then used to determine the tool design and tool fabrication manhours to produce the tool. By computerizing the approach, the expert or layman can review a much larger sample of a contractor's program special tool list, therefore improving the accuracy and firming the government negotiation position. The author feels further work is needed by a consultant company to extend the study to all aerospace tool types, to improve the data accuracy and to make the information readily available to Air Force plant representative offices and to buying offices needing to control program costs.

"Competition During Weapon System Acquistion" by Louis A. Kratz

Competitive procurement of defense goods and services long has been a stated objective of the Congress and the Department of Defense (DOD). Often, effective use of competition *during* weapon system development and production has been limited. Benefits that have been attributed to the continuous presence of competition include reduced and controlled costs, enhanced performance, reduced risk, and improved quality.

This paper presents the results of research on the effects of competition *during* development and production. The paper is based upon recent reviews of competitive Navy and Army programs and encompasses the following:

—Types of competition
—Competition during development
—Competition during production
—Areas for further research.

"Examining the AFSC Production Rate Model" by Captain Thurman D. Gardner, USAF

A current problem facing the cost estimator and the program manager is the need to assess program cost impacts resulting from changes in production rate. In responding to this problem, the Air Force System Command (AFSC) has developed the production rate model for providing quick, same-day responses.

The model is based on the assumption that the influence an increasing production rate has on decreasing the unit cost is limited. This idea follows the minimum cost point found on the long run average cost-curve in economic theory. In this case the point is determined by the manufacturer prior to production. This point is based on plant capacity, capital investment and manpower requirements, anticipated quantities and production rate, as well as requirements specified by the government.

The AFSC model modifies the learning-curve equation by including a variable representing production rate. This equation is used to estimate recurring costs. In addition, there is an internal data base of historical programs containing first unit cost, learning-curve slope, and production-rate slope generated with a non-linear regression technology. The non-linear regression technique was used to reduce the effects of multicollinearity and bias associated with ordinary least squares regression. Virtually all the literature addressing the subject agrees that in-

serting a variable representing production rate into the basic learning-curve equation produces statistically unrealiable resutls. The AFSC knows about, understands, and accepts the statistical limitation because the model was not intended to provide a pro forma budget submission. The model has been developed to provide a good approximation of the change in cost that results from a production rate change.

"Learning and Production Costs: An Application to a Fighter Airframe Program" by T. R. Gulledge, Jr., and N. K. Womer, and J. D. Camm

This research reports the application of a production cost model to a fighter airframe program. The model considers the effects of learning and production rate changes on discounted program cost. The estimation results indicate that this application compares favorably with that reported for other programs in previous research.

COST AND PRICING APPLICATIONS

"An Examination of Indirect Costs of Major Defense Systems Contractors" by F. M. Richardson, G. M. Cunningham, and J. M. Cathey

In today's defense systems acquisition environment an intense cost-consciousness is apparent. This consciousness is particularly strong in cost-plus contracts where almost all types of contractor costs can be passed along to the government. Of major interest are the indirect costs; there have been wide-spread allegations that contractors have no incentive to control them because they can be passed along to the government. This study examines reported selling, general, and administrative (SG&A) costs of major defense systems contractors using publicly available information as a means of examining a major portion of indirect costs. Results indicate that there is an inverse relationship between the percentage of government business and the level of selling, general, and administrative costs but that there is little difference between the level of selling, general, and administrative expenses for systems contractors and that of industry as a whole.

"Design to Cost Under Changing Program Conditions" by John C. Bemis

For weapon systems undergoing DSARC milestone reviews, examination of compliance to design-to-cost requirements is a normal part of the review process. Initial design-to-cost projections are made using the total quantities and production rates as foreseen at the initiation of the program. Since these quantities and production rates are subject to change during the life of the program, the design-to-cost projections are subject to change.

This paper proposes a methodology for adjusting the design to cost goals with changes in quantity and/or production rates. These adjustments can be made using a three-dimensional response surface, which is derived by using multiple regression techniques commonly available for microcomputers, or by constructing the model to pass through the original data point. This paper concentrates on the latter method.

ILS

"The New MIL-STD-1369-A, Integrated Logistic Support (ILS) Program Requirements" by Ewell E. Eubanks

This paper describes the latest innovative approach for standardization of ILS program requirements for all defense acquisitions. It contains a specific requirement for a government-developed ILS strategy, to include all contractor requirements. It places particular emphasis on planning, analysis, management (to include surveillance and control), proper program interface and ILS integration required for an effective ILS program. Primary data products generated under this standard are:

—Government-developed integrated logistic support plan (ILSP).

—Contractor-developed integrated support plan (ISP).

The ILSP contains the government (requiring authority) documented ILS program strategy. The ILSP is developed prior to milestone one and updated during each phase of the acquisition process. Major contents include:

—Maintenance concepts and preliminary technical data.

—Supportability planning requirements for all elements of ILS.

—ILS program milestones.

—LSA and LSAR interface requirements.

—Specific management and detailed ILS program tasks requirements.

The ISP represents the contractor-prepared and government-approved planning document, used by the contractor or performing activity (government or industry) to manage and execute the ILS program. The approved ISP is used by the government to monitor and evaluate the contract effort. The ILSP and ISP, together, form the single ILS planning and management document for the execution of an ILS program under DODD 5000.39.

"DOD Initiatives in LSA/LSAR" by John E. Peer

The concept for LSA was originally set forth in MIL-STD-1388-1, Logistic Support Analysis (LSA), published in October 1973. The lessons learned by the services, and industry policies and initiatives in the areas of integreated logistic support (ILS) and LSA, dictated that a complete revision of the MIL standard was required. This effort was undertaken by a joint service LSA working group composed of representatives from each of the services, defense industrial associations, and OUSDR&E, with the USAMC Materiel Readiness Support Activity (MRSA) as the primary author. This paper describes the status of these efforts to provide a standard Department of Defense approach to LSA with the broadest possible application. Also described is MIL-STD-1388-2A, "DOD Requirements for a Logisitic Support Analysis Record (LSAR)," which was published in July 1984, and the joint service LSAR ADP system which supports it. This military standard culminates a 5-year effort to standardize the documentation of LSA within the military services.

"Analytical Spares Screening Evaluation Technique Asset" by Richard Meyers and Elizabeth Randazzo

The benefits derived from the burn-in screening of electronic components, assemblies and systems to remove "infant mortality" failures and thereby enhance system reliability, are well

known. As a result, the technique of burn-in screening is required by the Navy and other DOD agencies for initial system/subsystem procurements. However, a specific methodology for quantifying how much burn-in screening is cost effective has not been available. This has resulted in subjective decision-making processes when establishing the required amount of burn-in screening. As a result, in many situations the requirements imposed in procurement specifications have been, and are being, established subjectively.

Of even more significance, is the fact that the procurement of spares is routinely performed without requirements for burn-in screening. Recognizing the need to have a quantitative technique for establishing a cost-effective level of burn-in screening the Naval Air Development Center (NAVAIRDEVCEN), under auspices of the Naval Air Systems Command (NAVAIRSYSCOM), and with contractor support has developed such a technique. This computerized model, is known as the analytical spares screening evaluation technique (ASSET) and provides the much needed methodology by which decision makers can establish cost effective burn-in screening requirements for procurement specifications. This paper concerns the ASSET computerized mathematical model and the information it provides. Input and output information contained in this paper are for illustrative purposes and are not intended to portray conclusions about actual aircraft.

"Predicting Life-Cycle Costs and Maintenance Requirements" by Marvin H. Agee, Kenneth W. Brammer, Wolter J. Fabrycky, Charles J. Malmborg, and Thomas P. Moore

The Markov Chain concept and bill of material concepts are combined in the development of a microcomputer-based model used in maintenance requirements planning for a population of repairable items. The uses of the model for "what if" gaming to evaluate the life-cycle effects of alternative procurement policies and item quality levels are discussed.

INDUSTRIAL MOBILIZATION

"Anatomy of Surge" by George T. Nickolas

This paper will discuss the background of surge and the confusion that exists among surge requirements, surge planning, and surge implementation. In August 1984, at the direction of General Thompson, commander of U.S. Army Materiel Readiness Command (AMC), a study was initiated to develop a "Requirements Driven" surge concept for AMC and all of its subordinate commands. The author, an expert on contracting for surge, was tasked to assist in the development of a practical surge program driven by requirements. The program baseline established would be to utilize the surge initiatives developed and used at HQ, U.S. Army Armament, Munitions and Chemical Command (AMCCOM) at Rock Island, Ill.

This paper will provide a practical method of establishing a variable surge program which would allow all Department of Defense procurement Activities to accomodate a Surge of requirements on contracts during an emergency determined to be short of war or full mobilization.

Attached to the paper will be the latest revisions to the surge data item description (DID) and the surge option clauses which have evolved from the study.

"Concepts for Industrial Mobilization" by Dr. Franz A. P. Frisch

Industrial mobilization is defined as the industrial growth according to the national need in wartime. In particular, the growth process starts with the industrial capabilities able to satisfy the military demand in peacetime and progresses toward the satisfaction of the military demand in war time.

From an objective analytical point of view, no difference exists between industrial growth in peace and industrial growth for war, because the internal elements of the industrial anatomy, meaning structure and function, operate identically and independently from the subjective exogenous elements of the growth process. The most important exogenous element is the forcing function or the motivator for growth; it shifts from the natural market forces in peacetime to a deterministic demand function in wartime. Consequently, the economic evaluators for peacetime growth shift toward political evaluators for wartime growth.

The paper starts with a cursory review of the exogenous determinants for growth and concentrates thereafter on the internal elements of industrial growth.

All possible internal growth patterns are bounded by three non-ambiguous concepts: (1) growth through increased manpower; (2) growth through extension or multiplication of existing facilities, and (3) growth through new manufacturing processes. Adaptation of existing commercial facilities to military goods, change in the utilization of existing facilities, improvements of productivity, and so forth, are all points within the area bounded by the three concepts and, in turn, each of the three non-ambiguous concepts is in its possible behavior embedded in the industrial anatomy and carries advantages and disadvantages for growth, dependent upon the product and the process used.

The paper continues with an overview of the industrial anatomy and an explanation of the pros and cons for the various growth potentialities, leading to the portrayal of the entire trade-off spectrum. This portrayal explains the contradiction and incompatibility between optimization for peacetime and a surge rate for wartime.

The paper closes with a summary of the findings based on the foregoing analyses and suggests a research plan to proceed from the theoretical foundation toward the development of a decision tool for mobilization oriented actions.

PRODUCT ASSURANCE

"Cost-Effectiveness of Warranties for DOD Weapon-System Procurements" by Kenneth B. Tom and Everett E. Ayers

Recent legislation requires the inclusion of warranties in DOD procurements of weapon systems. A new Subpart 46.7 has been published in the *Department of Defense Federal Acquisition Regulation Supplement* (DFARS) to provide guidance on the use of warranties in implementing the

requirements of the New Section 2403 to Title 10 of the United States Code. One of the questions that has repeatedly arisen in DOD about DFARS Subpart 46.7 is how to perform the required cost-benefit analysis to determine the cost-effectiveness of a warranty. It is DOD policy to only obtain warranties that are cost-effective. This paper presents three sets of techniques to be employed in structuring and analyzing cost-effective warranties: (1) the application of warranty economic analysis at different phases in a system's life cycle, (2) the identification of warranty cost factors, and (3) the use of available warranty cost models.

"A Unified Approach for Pricing Propulsion System Warranties and Guarantees" by Raymond S. Lieber

This paper discusses an approach for determing the value of warranties and guarantees. It uses the contractor's operations and support (O&S) model for performing risk assessment by expanding Weibull Analysis to account for design uncertainty through the use of Beta distributions. Three O&S model runs can be combined using a Beta distribution assumption to create a probability distribution related to what is being warranted such as cost per flying hour. The warranty or guarantee value can be analyzed using these probability distributions and related data. This analytical method combines the three warranties discussed in the *Joint Engine Warranty Guide* into a single unified warranty.

PROGRAM MANAGEMENT

"Life Cycle of Management Systems" by Henry C. Alberts

Today's system acquisition concepts have evolved over four decades. They are the product of the aggregate experience in managing procurement of complex products. Our present acquisition management system developed along with our understanding of the acquisition process. As such, it is a process management system.

Process management depends on three things:

—Understanding, in some detail, the process to be managed

—Generating detailed information about the process as it operates

—Integrating understanding with information to effect change.

The "process" viewpoint makes possible an analysis of how management systems function and an understanding of the key elements such systems require to provide effective control.

This paper focuses on the following problems:

1—The stability of the system acquisition process

2—The development of timely, accurate information during that process.

RISK AND UNCERTAINTY

"Development Planning: An Air Force Approach to Securing Greater Rewards from Today's Research" by Dr. L.G. Gaston and William K. Shilling III

Because history is replete with instances where a newly developed weapon, available at the right time, turned the tide of battle and, on occasion, led to the survival of an entire society, it is necessary to ask the question: What weapons will the Air Force require to help protect our country 5, 10, 20, or more years from now? This paper addresses the planning function that attempts to answer that question and to provide the initial impetus for the development and acquisition of such weapons. Development planning is the process of anticipating operational needs and technological opportunities, analyzing conceptual systems and sub-systems to meet those needs, and guiding the research necessary to support their transition into the validation and development programs that will, in turn, transform them into hardware: the weapons required for the Air Force of the future. Development planning is a distinctive and critical element in the process of focusing and applying today's research to gain tomorrow's rewards.

This paper briefly describes development planning at the Aeronautical Systems Division (ASD). It notes in passing the official guidelines for such planning and then illustrates the process by describing the steps that led to the present concept for the advanced tactical fighter or ATF. This review of the ATF's evolution clearly shows the planner's long-time horizon, and concern with both future operational needs and the promises and pitfalls of developing technologies.

"Risk Management" by Troy V. Caver

The pressure on program managers to perform more efficiently is always present. Yet, there is a growing tendency to reduce funds or place more requirements on the program without additional funds. Either situation will reduce the available funding for the task loading. With any required tradeoff or reduction in the system specification, there is increased risk. This paper provides insights and lessons learned through the Department of Defense system acquisition process in the management of risk.

Risk management is viewed and presented in a broad view that includes not only the technical risk of the system engineering but the other program managed functions that deal with the pragmatic risks of cost and schedule. In this regard, risk assessment, risk analysis, and development of risk handling techniques are all components of risk management. Each of these components is discussed in detail with some suggested methods of doing each. The concept of risk being induced from outside sources is discussed with some of the more common sources and their impacts on the program. Products of risk assessment and risk analysis are discussed with suggested uses of the products to aid in the risk management task. Risk handling techniques are discussed both in terms of ways to classify the method selected and consequences of each technique. Finally, some of the contractual processes that may be used for avoiding or handling program risk are presented.

The material concludes that risk management is not a product, it is a management discipline which requires the use of analysis and planning to develop the appropriate strategies, contract types, and management reviews. A further conclusion is that the approach presented is not unique to the Department of Defense, program management or procurement. It is appropriate for every major decision in life that justifies the allocation of time and discipline to a structured approach for decision-making.

"Risk Management During System Acquisition" by J. R. Nelson

The process of structuring, developing and implementing a risk management system for major acquisitions provides a disciplined and consistent approach to identifying, assessing, indicating, and tracking and reporting technical, schedule, and cost risks. This process and its reporting products provide the ability to monitor and evaluate such risks. Decisions for controlling and adjusting resources and/or requirements to mitigate identified risks can be more timely. A risk management system structure and reporting system was developed for the Navy Torpedo Mk 50 Program using the "Templates" document (Draft DODD 4245.7-M) as a guide. More recently, an integrated data base technical, schedule, and cost risk software package has been developed for the Air Force A-10/TEMS Program. On the basis of that experience, it is believed that a tailored yet flexible risk management system will be useful to program offices in the management of a variety of major acquisitions.

SOCIO-ECONOMIC CONSIDERATIONS

"Federal Agency R&D Contract Awards: The Impact on Small Firms of SFAS No.2" by Bertrand Horwitz and Daniel Normolle

In 1975, the Financial Accounting Standards Board and the Securities and Exchange Commission mandated that all firms expense privately-funded research and development outlays, although approximately 30-40 percent of smaller companies were previously capitalizing (deferring) such expenditures. Prior studies had detected a decline in investment of privately funded R&D following the mandate and attributed the decline to the desire to reduce the negative impact on key accounting levels and ratios that followed the mandate. It also was suggested that there was complementariness between privately funded and government funded R&D, and that the decline in privately funded R&D was connected with the reduced ability of firms to be awarded government contracts. This study tests the hypothesis that changes in the method of accounting measurement for research and development (SFAS No. 2 and SEC-ASR No. 178) affected the ability of small high-technology firms to secure federal agency contract awards for R&D. Many of these firms had significantly negative changes in the financial levels and ratios used by federal agency analysts in evaluating financial capability of contract bidders as part of a pre-award survey. An analysis of variance of 101 small research-intensive firms did not indicate significant differences in federal R&D contract awards between those which expensed privately funded R&D expenditures and those which, prior to the mandated changes in 1975, had deferred such expenditures. A similar conclusion was reached based upon an analysis of a subsample of expensing and deferring firms matched by size and industry. ■

INSIDE DSMC

People on the Move

Kerpelman

Rittenhouse

J. William Kerpelman is the adjunct professor of management in the Department of Research and Information. For the past 18 years, he was a management analysis officer at the Naval Air Systems Command. Mr. Kerpelman holds a B.E. degree from Johns Hopkins University, and an M.B.A. degree from American University.

Sandra Rittenhouse is a professor of systems acquisition management in the Department of Research and Information. She came to DSMC from the Army Materiel Command, where she was a policy specialist. Mrs. Rittenhouse received a B.S. degree from the University of Puget Sound, and an M.Ed. degree from the College of William and Mary.

Additions

Mary Easter and Dorothy Kelley to Acquisition Management Laboratory.

Magna Sweede to Technical Management Department.

Promotions

SFC Melvin Mosley, USA, Chief of Military Personnel Division, selected for promotion to master sergeant (E-8).

Losses

Dr. Gary P. Belcher, Acquisition Management Laboratory, DSMC staff member since 1971, to General Electronics Systems Division, Syracuse, N.Y., to be antisubmarine warfare systems analyst.

John Bruce, registrar.

Colonel Thomas V. Forburger, USA, deputy commandant, retired. He is associated with the Raytheon Co., Arlington, Va.

Lieutenant Colonel Ronald L. Fradenburg, USAF, Technical Management Department, to Wright-Patterson Air Force Base, Ohio.

Edward G. Ingalls, PMSS Directorate, to the Defense Logistics Agency to be the study director for acquisition management.

Lieutenant George J. Karol III, USN, executive officer, Office of the Commandant, to Newport, R.I., Naval Base for a 6-month department head course after which he will report for 3 years of sea duty.

Ruth Kuykendall, Department of Research and Information, resigned to complete her last year of nursing school.

James H. Rossi, Business Management Department, to NAVAIR.

Betty Sheehan, Acquisition Management Laboratory.

Clarence H. Steen, Policy and Organization Management Department, retired.

Perry C. Stewart, holder of the Army Chair, Executive Institute, to new assignment at Rock Island, Ill.

Lieutenant Colonel Leslie R. Swanson, USAF, Acquisition Management Laboratory, retired after 20 years of military service. He is associated with Boeing Co., Seattle, Wash.

Defense Systems Management College
Alumni Association
An Invitation to Join

The Defense Systems Management College Alumni Association was established on October 20, 1983, by a group of Program Management Course graduates representing every PMC class.

The Association provides a forum for advancing the professional growth of the defense acquisition community and is a source of experienced acquisition management professionals available to contribute to the growth and effectiveness of DSMC.

Since the initial meeting, membership has grown to more than 800, representing every PMC class, the forerunner course at Wright-Patterson AFB, as well as Associate members who have completed DSMC short courses and individuals who serve in key defense acquisition management positions. The Association has members in all areas of the country, as well as in Australia, Germany, the Netherlands, Scotland, and Korea.

Regular Member:
PMC graduate, or DSMC faculty/staff at least 2 years.

Associate Member:
Short course graduate, or DSMC faculty/staff less than 2 years, or others holding key defense acquisition program management positions.

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"Only Regular Members shall be entitled to vote, hold elected office or be appointed to chair a standing committee of the Association. Associate Members may nominate candidates for office, and serve as committee members, but may not vote, except that Associate Members shall from their group elect a representative to serve on the board of Directors."

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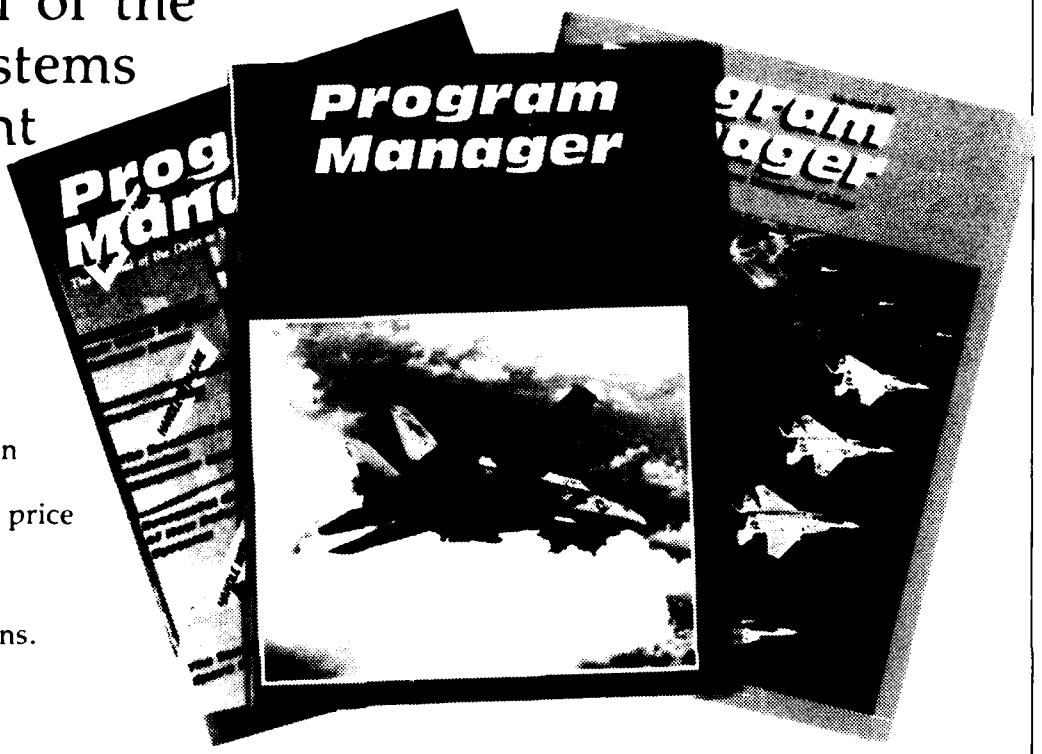

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Send Us Your Articles

Some Tips for Authors

The editors of *Program Manager*, DSMC's bimonthly journal, are interested in your thoughts on policies, trends, and events in the areas of program management and defense systems acquisition. We invite you to submit articles and share your experiences. We are interested in lessons you have learned through your acquisition experiences, both successful and otherwise.

Beyond the demand for good grammar, we have some tips for prospective authors. Consistency and uniformity should be uppermost. The renowned stylist William Strunk, Jr., said, "If those who have studied the art of writing are in accord on any one point, it is this: the surest way to arouse and hold the attention of the reader is by being specific, definite and concrete."

Style

Write in the first person, *I, we, our;* and use *you* often. Active verbs are best. Write naturally and avoid stiltedness. Except for a change of pace, keep most sentences to 25 words or less, and paragraphs to six sentences. We reserve the right to edit for clarity and space limitations.

Published articles will include your byline, and brief biography. When there are substantial editorial changes, *Program Manager* clears edited copy with the author.

Where possible, clear articles through your public affairs office or an equivalent authority. Most of the articles we publish are routinely reviewed and cleared by the Director, Security Review, Office of the Assistant Secretary of Defense for Public Affairs.

Length and Graphics

The Basics: Double-space your article using only one side of the paper. One double-spaced page, with a one-inch border on all sides, equals about 250-300 words. We are flexible regarding length, but prefer 2,000-3,000-word articles, which is about 10 double-spaced pages. Don't feel constrained by length requirements; say what you have to say in the most direct way, regardless of length.

We use figures, charts, and photographs. We prefer glossy, black and white photographs, five-by-seven or eight-by-ten, but we cannot guarantee the return of photographs. Do not write anything on the back of photographs. Photocopies of photographs are not acceptable. Charts and figures should be sharp and clear, with legible information and captions. We prefer camera-ready art, but the DSMC Graphic Arts Division can work with sketches if they are clear and precise.

Attribute all references you have used in researching your article. We use separate footnotes, which should be identified at the appropriate place in the copy.

Stories that appeal to our readers, who are senior military and civilian people in the program management/acquisition business, are those taken from *your own* experience rather than pages of "researched information."

Again, be sure to double-space your copy and use only one side of the paper.

If you need to talk to an editor, call:

Robert W. Ball, (703) 664-5974 or 664-5082; Autovon 354-5974 or 354-5082.

Catherine M. Clark, (703) 664-5992 or 664-5082; Autovon 354-5992 or 354-5082.

Or, write us at the Defense Systems Management College, Fort Belvoir, Virginia 22060-5426: ATTN: DRI-P. ■

Code of Ethics for Government Service

A message from the Secretary of Defense and the Inspector General.

Any person in the government service shall:

—put loyalty to the highest moral principles and to country above loyalty to persons, party or government department

—uphold the Constitution, laws and legal regulations of the United States and all governments therein and never to be party to their evasion

—give a full day's labor for a full day's pay, giving to the performance of his duties his earnest and best thought

—seek to find and employ more efficient and economical ways of getting tasks accomplished

—never discriminate unfairly by dispensing of special favors or privileges to anyone, whether for remuneration or not; and never accept, for himself or his family, favors or benefits under circumstances which might be construed by reasonable persons as influencing the performance of his government duties

—make no private promises of any kind binding the duties of office, since the government employee has no private word which can be binding on public duty

—engage in no business with the government, either directly or indirectly, which is inconsistent with the conscientious performance of his governmental duties.

—uphold these principles, ever conscious that public office is a public trust.

Public Law 96303 July 3 1980

Facts About the Pentagon

Area covered by building:
29 acres

Number of windows:
7,748

Original cost of Pentagon land:
$2,245,000

END

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